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today

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FOCUS

**Class
XI**

NEET/JEE 2019

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UNIT - 7 : Organic Chemistry-Some Basic Principles and Techniques

- Organic chemistry deals with the study of hydrocarbons (compounds of carbon and hydrogen elements) and other compounds regarded as derivatives of hydrocarbons. Some organic compounds may also contain nitrogen, oxygen, sulphur, phosphorus, halogens, etc.

Structure	Tetrahedral	Trigonal planar	Linear
Examples	Ethane, methane	Ethene, propene	Ethyne, prepyne

TETRAVALENCY OF CARBON

Carbon atom has four half filled orbitals in its excited state and hence, forms four covalent bonds.

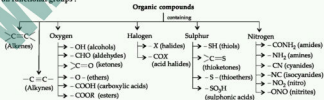
Hybridisation	sp^3	sp^2	sp
Number of equivalent orbitals formed	4	3	2
Unhybridised orbitals	0	1	2

CLASSIFICATION OF ORGANIC COMPOUNDS

Based on structure :



Based on functional groups :





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NOMENCLATURE OF ORGANIC COMPOUNDS

IUPAC Nomenclature : The complete IUPAC name of an organic compound consists of five parts :

Secondary prefix	Primary prefix	Word root	Primary suffix	Secondary suffix
Indicates the nature of side chains and substituents attached to longest chain selected	Indicates the presence of alicyclic system (cyclo = alicyclic)	Indicates the number of carbon atoms in a suitably selected longest continuous chain of carbon atoms.	Indicates the nature of C—C bond in the longest chain selected (-ane : C—C single bond) (-ene : C=C double bond) (-yne : C≡C triple bond)	Indicates the nature of functional group.

Rules for Nomenclature

- **Longest chain rule :** The very first step for naming an organic compound is to select longest continuous carbon chain, which may be either straight or branched. This is called principal chain or parent chain.
- **Numbering of the principal chain :** The principal carbon chain is numbered from one end to other by numerals (1, 2, 3, 4, ...) in such a way that it gives the lowest possible number to the carbon atom carrying the substituent.
- **Lowest set of locants rule :** When the parent chain has two or more substituents, numbering should be done in such a way that sum of the locants on the parent chain is lowest possible number. This is also known as lowest sum rule.
- **Alphabetical order of the substituents :** When two or more substituents are present on the parent chain, then these substituents prefixed with their position number are arranged in alphabetical order

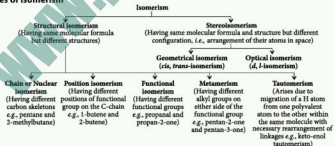
(irrespective of the position number) before word root.

- **Naming same group at different positions :** When the same substituent occurs more than once on the parent chain, position of each substituent separated by commas is mentioned with suitable prefix such as *di* (for two), *tri* (for three), *tetra* (for four).
- **Naming of complex substituent :** If the substituent on the parent chain is complex (i.e. branched), it is named as a substituted alkyl group by numbering the group in the same manner as the numbering of parent chain has been done, starting with the carbon atom directly attached to the parent chain.

ISOMERISM

Two or more compounds possessing same molecular formula but different physical and chemical properties are known as isomers and the phenomenon is called isomerism.

Types of Isomerism



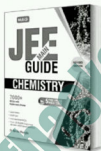
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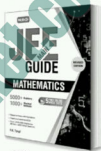
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REACTION MECHANISM AND INTERMEDIATES

Fission of a Covalent Bond

- A covalent bond can get cleaved either by :
 - Heterolytic cleavage** : It involves breaking of a covalent bond in such a fashion that the shared pair of electrons remains with one of

the fragments, which results in the formation of carbocations or carbanions as intermediates.

- Homolytic cleavage** : It involves breaking of a covalent bond in such a fashion that one of the electrons of the shared pair goes with each of the bonded atom, which results in the formation of free radicals as intermediates.

Reaction Intermediates

Intermediates	Definition	Hybridisation of carbon and shape	Stability order
Carbocation	Carbon species carrying +ve charge on carbon.	sp^2 hybridised carbon and planar structure.	$3^\circ > 2^\circ > 1^\circ$
Carbanion	Carbon species carrying -ve charge on carbon.	sp^3 hybridised carbon and pyramidal shape.	$1^\circ > 2^\circ > 3^\circ$
Free radical	Atom or group of atoms having odd or unpaired electron.	sp^2 hybridised carbon and planar structure.	$3^\circ > 2^\circ > 1^\circ$

Attacking Reagents

Reagent	Description	Examples
Electrophiles (Electro = Electron, phile = loving)	They are positively charged or neutral molecules having electron deficient atom, seeking a site of high electron density. Electrophiles have an incomplete outer shell and are also called <i>Lewis acids</i> (electron-pair acceptors).	Charged : H_3O^+ , X^+ (where $X = Cl, Br, I$), NO_2^+ , NO^+ , NH_4^+ , SO_3H , $C_6H_5^+$, R^+ , RCO^+ . Neutral : BF_3 , $AlCl_3$, $FeCl_3$, $SiCl_4$, $BeCl_2$, $ZnCl_2$, SO_3 , CO_2 , CS_2 , CX_4 , $RCOCl$, $>C=O$, $RCOCl_2$ etc.
Nucleophiles (Nucleo = nucleus, phile = loving)	They are negatively charged or neutral molecules having electron-rich atom with unshared electron pair, seeking electron deficient site to attack. They are also called <i>Lewis bases</i> (electron-pair donors).	Charged : H^- , OH^- , X^- , CN^- , N_3^- , RO^- , R^-, RS^- , SH^- , HSO_3^- , NO_2^- , NH_2^- , $RCOO^-$, $HC \equiv C^-$. Neutral : $\ddot{N}H_3$, $H_2C=\ddot{C}$, $R_2\ddot{O}$, $R_2\ddot{N}$, $R_3\ddot{S}$, $RMgX$, Ph_3P , RLi , $LiAlH_4$, etc.
Ambiphiles (ambidents)	They behave like both electrophiles and nucleophiles hence, have dual nature (amphoteric).	Charged : H_2O : Neutral : $R_2\ddot{O}$, $H_2C=\ddot{C}$ and RPH_2 , etc.

ELECTRONIC DISPLACEMENT EFFECTS IN COVALENT BONDS

Inductive Effect

- It involves displacement of σ electrons along a saturated carbon chain when an electron donating (+I effect) or electron withdrawing (-I effect) group is attached at the end of the carbon chain.
- Decreasing order of -I effect** : $-NO_2 > -CN > -COOH > -F > -Cl > -Br > -I > -H$
- Decreasing order of +I effect** : $(CH_3)_3C^- > (CH_3)_2CH^- > CH_3CH_2^- > CH_3^- > D^- > H^-$

Electromeric Effect

- It involves complete transfer of π electrons of a multiple bond towards one of the bonded atoms in the presence of an attacking reagent.
- +E effect when electron transfer takes place towards the atom to which the attacking reagent gets attached.
- E effect when electron transfer takes place away from the atom to which the attacking reagent gets attached.

Resonance or Mesomeric Effect

- It is defined as the polarity produced in the molecule by the interaction of two π bonds or between a

π bond and a lone pair of electrons present on adjacent atom.

- **+R or +M effect** : $-\text{OH}$, $-\text{OR}$, $-\text{SH}$, $-\text{SR}$, $-\text{NH}_2$, $-\text{NHR}$, $-\text{NR}_2$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, etc.
- **-R or -M effect** : $>\text{C}=\text{O}$, $-\text{CHO}$, $-\text{COOR}$, $-\text{CN}$, $-\text{NO}_2$, etc.

Hyperconjugation

- It involves delocalisation of σ electrons of C—H bond of an alkyl group directly attached to an atom of unsaturated system or to an atom with an unshared p -orbital. For an alkyl group attached to unsaturated system it decreases with decrease in number of α -hydrogens:
 $\text{CH}_3- > \text{CH}_3\text{CH}_2- > (\text{CH}_3)_2\text{CH}- > (\text{CH}_3)_3\text{C}-$

TYPES OF ORGANIC REACTIONS

Substitution or Displacement Reactions

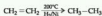
- In these reactions an atom attached to a carbon atom in a molecule is replaced by another atom or group.
 $\text{CH}_4 + \text{Cl}_2 \xrightarrow{\text{UV light}} \text{CH}_3\text{Cl} + \text{HCl}$
- These are of three types :
 - **Free radical substitution** : When the attacking species is free radical.
 - **Electrophilic substitution** : When the attacking species is electrophile.
 - **Nucleophilic substitution** : When the attacking species is nucleophile.

Addition Reactions

- In these reactions attacking reagent adds up to the substrate without eliminations.

The methods commonly used for purification are :

Method	Used for separating	Examples
Crystallisation	Mixtures with difference in the solubility of the organic compound and its impurities in a solvent.	<ul style="list-style-type: none"> • Sugar with impurity of common salt can be crystallised from hot ethanol (sugar dissolves but salt does not).
Sublimation	Mixtures of sublimable volatile compounds and non-sublimable impurities.	<ul style="list-style-type: none"> • Purification of campher, anthracene, naphthalene, benzoic acid, etc.
Distillation	Mixtures of liquids which boil without decomposition and contains non-volatile impurities.	<ul style="list-style-type: none"> • Chloroform (b.pt. 334 K) and aniline (b.pt. 457 K).
Fractional distillation	Mixtures of two or more miscible liquids which have b.pt. close to each other.	<ul style="list-style-type: none"> • Ether (b.pt. 308 K) and toluene (b.pt. 383 K). • Acetone (b.pt. 330 K) and methyl alcohol (b.pt. 338 K). • Benzene (b.pt. 353 K) and toluene (b.pt. 384 K).



- These are also of three types :

- Free radical addition
- Electrophilic addition
- Nucleophilic addition

Elimination Reactions

- In these reactions generally atoms from two adjacent atoms are removed and multiple bond is formed. It is just reverse of addition reactions.

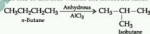


- These are of three types:

- **α -elimination reactions**: Elimination occurs from the same atom of the substrate molecule.
- **β -elimination reactions**: Elimination occurs from the adjacent atom of the substrate molecule.
- **γ -elimination reactions**: Elimination occurs from α - and γ -positions (i.e., three bonds away) of the substrate molecule leading to the formation of the three-membered rings.

Rearrangement Reactions

- In these reactions, migration of an atom or a group from one site to another within the molecule takes place.



METHODS OF PURIFICATION OF ORGANIC COMPOUNDS

- The methods employed for purification depend upon the nature of substance and the type of impurity present in it.

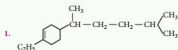
Halogens	$\text{Na} + \text{X} \xrightarrow{\Delta} \text{NaX}$ (L.E.)	L.E. + $\text{HNO}_3 + \text{AgNO}_3$ <ul style="list-style-type: none"> White ppt. soluble in aq. NH_3 (or NH_4OH) confirms Cl. Yellow ppt. partially soluble in aq. NH_3 (or NH_4OH) confirms Br. Yellow ppt. insoluble in aq. NH_3 (or NH_4OH) confirms I. 	$\text{NaX} + \text{AgNO}_3 \xrightarrow{\text{HNO}_3} \text{AgX} \downarrow$ ppt. $\text{AgCl} + 2\text{NH}_3(\text{aq}) \rightarrow [\text{Ag}(\text{NH}_3)_2]\text{Cl}$ White ppt. Soluble
Nitrogen and sulphur together	$\text{Na} + \text{C} + \text{N} + \text{S} \xrightarrow{\Delta} \text{NaSCN}$ Sodium thiocyanate (L.E.)	As in test for nitrogen; instead of green or blue colour, blood red colouration confirms presence of N and S both.	$3\text{NaSCN} + \text{FeCl}_3 \rightarrow \text{Fe}(\text{SCN})_3$ Blood red colour + 3NaCl
Phosphorus	$\text{P} \xrightarrow[\Delta]{\text{Na}_2\text{O}_2, \text{boil}} \text{Na}_3\text{PO}_4$	Solution is boiled with nitric acid and then treated with ammonium molybdate $(\text{NH}_4)_2\text{MoO}_4$. Formation of yellow ppt. indicates presence of phosphate (hence, phosphorus) in organic compound.	$\text{Na}_3\text{PO}_4 + 3\text{HNO}_3 \rightarrow \text{H}_3\text{PO}_4 + 3\text{NaNO}_3$ $\text{H}_3\text{PO}_4 + 12(\text{NH}_4)_2\text{MoO}_4 + 21\text{HNO}_3 \rightarrow (\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3 \downarrow$ Ammonium phosphomolybdate (yellow ppt.) $+ 21\text{NH}_4\text{NO}_3 + 12\text{H}_2\text{O}$

QUANTITATIVE ANALYSIS OF ORGANIC COMPOUNDS

- The percentage composition of elements present in an organic compound is determined by the methods based on the following principles:

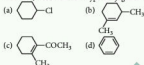
Element	Method
Carbon and Hydrogen	Liebig's Combustion method: $\% \text{ of C} = \frac{12}{44} \times \frac{\text{mass of CO}_2 \text{ formed}}{\text{mass of compound taken}} \times 100$; $\% \text{ of H} = \frac{2}{18} \times \frac{\text{mass of H}_2\text{O formed}}{\text{mass of compound taken}} \times 100$
Nitrogen	Dumas method: $\% \text{ of N} = \frac{28}{22400} \times \frac{\text{vol. of N}_2 \text{ at STP}}{\text{mass of compound taken}} \times 100$ Kjeldahl's method: $\% \text{ of N} = \frac{1.4 \times \text{molarity of acid} \times \text{vol. of acid used} \times \text{basicity of acid}}{\text{mass of compound taken}}$
Halogens	Carius method: $\% \text{ of X} = \frac{\text{At. mass of X}}{108 + \text{At. mass of X}} \times \frac{\text{mass of AgX formed}}{\text{mass of compound taken}} \times 100$
Sulphur	Carius method: $\% \text{ of S} = \frac{32}{233} \times \frac{\text{mass of BaSO}_4 \text{ formed}}{\text{mass of compound taken}} \times 100$
Phosphorus	Ignition method: $\% \text{ of P} = \frac{62}{222} \times \frac{\text{mass of Mg}_2\text{P}_2\text{O}_7 \text{ formed}}{\text{mass of compound taken}} \times 100$
Oxygen	Iodine method: $\% \text{ of O} = \frac{32}{88} \times \frac{\text{mass of CO}_2 \text{ formed}}{\text{mass of compound taken}} \times 100$ or $\% \text{ of O} = \frac{5 \times 16}{2 \times 127} \times \frac{\text{mass of I}_2 \text{ formed}}{\text{mass of compound taken}} \times 100$

SPEED PRACTICE

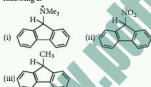


- The IUPAC name of above compound will be
 (a) 1-ethyl-4-(5-methylhexyl) cyclohex-1-ene
 (b) 1-ethyl-4-(1,4-dimethylpentyl) cyclohex-1-ene
 (c) 5-(1,4-dimethylpentyl)-2-ethylcyclohex-1-ene
 (d) 4-(1,4-dimethylpentyl)-1-ethylcyclohex-1-ene.

2. In which of the following molecules all the effects-inductive, mesomeric and hyperconjugation operate?



3. The acidity order of the protons (H) in each of the following is



- (a) i > ii > iii
 (b) ii > iii > i
 (c) ii > i > iii
 (d) iii > i > ii

4. The dipole moment of vinyl chloride is lower than that of ethyl chloride. This is due to

- (a) resonance effect
 (b) inductive effect
 (c) electromeric effect
 (d) hyperconjugation effect.

5. The hyperconjugative stabilities of *tert*-butyl cation and 2-butene, respectively, are due to

- (a) $\sigma \rightarrow p$ (empty) and $\sigma \rightarrow \pi^*$ electron delocalisations
 (b) $\sigma \rightarrow \sigma^*$ and $\sigma \rightarrow \pi$ electron delocalisations
 (c) $\sigma \rightarrow p$ (filled) and $\sigma \rightarrow \pi$ electron delocalisations
 (d) p (filled) $\rightarrow \sigma^*$ and $\sigma \rightarrow \pi^*$ electron delocalisations.

(JEE Advanced 2013)

6. Arrange the carbanions, $(\text{CH}_3)_3\text{C}^-$, $\text{C}_6\text{H}_5\text{CH}_2^-$, $(\text{CH}_3)_2\text{CH}^-$, $\text{C}_6\text{H}_5\text{CH}_2^-$, in order of their decreasing stability.
 (a) $\text{C}_6\text{H}_5\text{CH}_2^- > \text{C}_6\text{H}_5\text{CH}_2^- > (\text{CH}_3)_2\text{CH}^- > (\text{CH}_3)_3\text{C}^-$
 (b) $(\text{CH}_3)_2\text{CH}^- > \text{C}_6\text{H}_5\text{CH}_2^- > \text{C}_6\text{H}_5\text{CH}_2^- > (\text{CH}_3)_3\text{C}^-$
 (c) $\text{C}_6\text{H}_5\text{CH}_2^- > \text{C}_6\text{H}_5\text{CH}_2^- > (\text{CH}_3)_2\text{CH}^- > (\text{CH}_3)_3\text{C}^-$
 (d) $(\text{CH}_3)_2\text{CH}^- > (\text{CH}_3)_2\text{CH}^- > \text{C}_6\text{H}_5\text{CH}_2^- > \text{C}_6\text{H}_5\text{CH}_2^-$

7. Consider the following reactions.

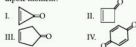


In which cases, parent compound loses its functional group in preference?

- (a) I, II
 (b) I, II, III
 (c) II, III
 (d) I, III

8. Which of the following is an electrophilic reagent?
 (a) H_2O (b) NH_3 (c) OH^- (d) NO_2^+

9. Which of the following compounds will show highest dipole moment?



- (a) I
 (b) III
 (c) II
 (d) IV (JEE Main 2017)

10. Pure (+)-2-butanol has a specific rotation of $+13.52^\circ$.

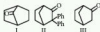
A sample of 2-butanol prepared in the laboratory and purified by distillation has a specific rotation of -6.76° . What is the composition of the mixture?

- (a) 20% (+)-2-Butanol + 80% (-)-2-Butanol
 (b) 50% (+)-2-Butanol + 50% (-)-2-Butanol
 (c) 60% (+)-2-Butanol + 20% racemic mixture
 (d) 50% (-)-2-Butanol + 25% racemic mixture

11. A sample of 0.50 g of an organic compound was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50 mL of 0.5 M H_2SO_4 . The residual acid required 60 mL of 0.5 M solution of NaOH for neutralisation. What would be the percentage composition of nitrogen in the compound?

- (a) 50 (b) 60 (c) 56 (d) 44

12. Which among the given molecules can exhibit tautomerism?



- (a) III only (b) Both I and III
(c) Both I and II (d) Both II and III

(NEET 2016)

13. Lassaigne's test is not shown by diazonium salts because they

- (a) form NH_3 gas on heating much before the reaction with sodium
(b) form N_2 gas on heating much before the reaction with sodium
(c) are highly volatile and evaporate before the reaction with sodium
(d) all of the above.

14. Which of the following are correct for the addition of X_2 on alkene?

- (a) Reaction involves cyclic halonium ion as intermediate.
(b) Reaction involves carbocation intermediate.
(c) Addition is *syn*-addition reaction.
(d) Symmetrical *cis* alkene gives meso product.

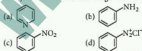
15. Two pure organic solid samples were found to have nearly the same melting point. The melting point of a 1 : 1 mixture of the two was found to be lower by about 15°C . This means that the two samples contain

- (a) chloro compounds
(b) identical compounds
(c) different compounds
(d) isomorphous compounds.

16. Heterolysis of a carbon-chlorine bond produces

- (a) two free radicals
(b) two carbocations
(c) one cation and one anion
(d) two carbanions.

17. Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimation?



(JEE Main 2018)

18. In which of the following compounds, the carbon marked with asterisk is expected to have greatest positive charge?

- (a) $^*\text{CH}_3 - \text{CH}_2 - \text{Br}$ (b) $^*\text{CH}_3 - \text{CH}_2 - \text{Cl}$
(c) $^*\text{CH}_3 - \text{CH}_2 - \text{CH}_3$ (d) $^*\text{CH}_3 - \text{CH}_2 - \text{MgCl}$

19. Dichlorocarbene is generated by the action of potassium *t*-butoxide on chloroform. This is an example of

- (a) α -elimination reaction
(b) β -elimination reaction
(c) addition reaction
(d) rearrangement reaction.

20. Decreasing order of stability of following alkenes is

- (i) $\text{CH}_3 - \text{CH} = \text{CH}_2$
(ii) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$
(iii) $\text{CH}_3 - \text{C} = \text{CH} - \text{CH}_3$



- (iv) $\text{CH}_3 - \text{C} = \text{C} - \text{CH}_3$

- (a) (i) > (ii) > (iii) > (iv)
(b) (iv) > (iii) > (ii) > (i)
(c) (iii) > (ii) > (i) > (iv)
(d) (ii) > (iii) > (iv) > (i)

For the SCIENTIST in YOU

Wearable sensor checks blood alcohol content using sweat



Device shows how sweat could be used as a non-invasive source of biochemical information

Sweat alcohol levels correlate with blood alcohol levels, new research confirms. The findings come from a study by US researchers who have made a wearable device that stimulates sweat production and measures its ethanol concentration every 25 seconds. The system could be developed to track important analytes like hormones, or pharmaceuticals, to tell users how drugs are metabolising in their body in real time.

21. The correct match between items of List-I and List-II is

List-I	List-II
A. Coloured impurity	P. Steam distillation
B. Mixture of <i>o</i> -nitrophenol and <i>p</i> -nitrophenol	Q. Fractional distillation
C. Crude naphtha	R. Charcoal treatment
D. Mixture of glycerol and sugars	S. Distillation under reduced pressure

(a) (A)-(R), (B)-(S), (C)-(P), (D)-(Q)
 (b) (A)-(R), (B)-(P), (C)-(Q), (D)-(S)
 (c) (A)-(P), (B)-(S), (C)-(R), (D)-(Q)
 (d) (A)-(R), (B)-(P), (C)-(S), (D)-(Q)

(JEE Main 2018)

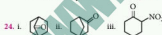
22. Which of the following correctly shows the order of decreasing percentage of nitrogen (by mass) present in the following compounds?

- (a) $C_3H_9N_3 > C_6H_{12}N_4 > C_2H_8N_2$
 (b) $C_3H_8N_2 > C_3H_6N_3 > C_6H_{12}N_4$
 (c) $C_3H_8N_3 > C_2H_8N_2 > C_6H_{12}N_4$
 (d) $C_6H_{12}N_4 > C_3H_8N_3 > C_2H_8N_2$

23. The correct statement regarding electrophile is

- (a) electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile
 (b) electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile
 (c) electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile
 (d) electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from a nucleophile.

(NEET 2017)



Among these compounds, which of the following is the correct order of % enol content?

- (a) i > ii > iii (b) iii > ii > i
 (c) ii > iii > i (d) i > iii > ii

25. The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20 mL of 0.5 M sodium hydroxide solution for complete neutralization. The organic compound is

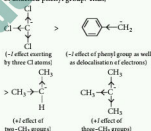
- (a) urea (b) benzamide
 (c) acetamide (d) thiourea.



SOLUTIONS

1. (b) 2. (c)
 3. (c): $-NMe_3$ shows only $-I$ effect.
 $-NO_2$ shows $-R$ effect.
 $-CH_3$ shows $+I$ effect.
 4. (a): The dipole moment of vinyl chloride is lower than that of CH_3CH_2Cl due to resonance effect.



5. (a)
 6. (c): $-I$ effect (e^- withdrawing) exerting groups stabilise carbanion by the dispersal of their $-ve$ charge while $+I$ effect (e^- releasing) exerting groups destabilise the carbanion by increasing electron density on them.
 On the other hand, resonance stabilised carbanion are stable due to the involvement of their lone pair of electrons with the delocalization of π -electrons of attached phenyl group. Thus,



7. (a): I. $\text{CH}_2=\text{CHCOOH} \rightarrow \text{CH}_2=\text{CH}_2$
 $-\text{COOH}$ loses its preference
 II.  \rightarrow 
 acid ketone
 $-\text{COOH}$ loses its preference
 III. $\text{CH}_3\text{CH}(\text{COOH})\text{COOH} \rightarrow \text{CH}_3\text{CH}_2\text{COOH}$
 $-\text{COOH}$ does not lose its preference
 8. (d): Electron deficient species act as electrophiles i.e., NO_2^+ .

9. (a)

10. (d): Whenever a chiral compound is prepared in the laboratory, we usually get a racemic mixture with some inversion since the attack of the nucleophile from the back exceeds the attack from the front. Since 25% racemisation has zero contribution towards specific rotation, therefore, the observed optical rotation is due to 50% inversion, i.e., 50% of (-)-2-butanol with specific rotation of -13.52° .

$$\therefore \alpha_{\text{obs}} = \frac{50}{100} \times (-13.52^\circ) = -6.76^\circ$$

11. (c): Mass of compound taken = 0.50 g
Vol. of H_2SO_4 = 50 mL
Molarity of H_2SO_4 = 0.5 M
Vol. of NaOH required = 60 mL
Molarity of NaOH required = 0.5 M

$$\% \text{ of N} = \frac{1.4 \times M \times 2 \left\{ V - \frac{V_1}{2} \right\}}{m}$$

By substituting the values in the formula, we get,

$$\% \text{ of N} = \frac{1.4 \times 0.5 \times 2(50 - 60/2)}{0.5} = 56$$

$$\therefore \% \text{ of N in the given compound} = 56\%$$

12. (a) 13. (b) 14. (a)

15. (c): Mixed melting point is depressed if the two solid organic compounds are different.

16. (c)

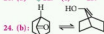
17. (b): Kjeldahl's method is very convenient method. This method is suitable for estimating nitrogen in those organic compounds in which nitrogen is linked to carbon and hydrogen. This method is not used in case of nitro, azo and azoxy compounds and to compound containing nitrogen in the ring (e.g., pyridine, quinoline, isoquinoline, etc.).

18. (b)

19. (a): α -Elimination reaction since both H and Cl are lost from the same carbon.

20. (b): Higher the number of α -H, more the hyperconjugating structures, more the stability of the compound.

21. (b) 22. (c) 23. (c)



Highly unstable as it bond is on bridge head carbon



25. (a): Equivalent of NH_3 evolved

$$= \frac{100 \times 0.1 \times 2}{1000} - \frac{20 \times 0.5}{1000} = \frac{1}{100}$$

Percent of nitrogen in the unknown organic compound

$$= \frac{1}{100} \times \frac{14}{0.3} \times 100 = 46.6\%$$

Percent of nitrogen in urea $(\text{NH}_2)_2\text{CO}$

$$= \frac{14 \times 2}{60} \times 100 = 46.6\%$$

\therefore The compound must be urea.

PUZZLE CORNER

SOLUTION - DECEMBER 2018

(a) Beryllium $(6 - 2) = 4$ (b) Chromium $(6 \times 1 \times 4) = 24$ (c) Phosphorus $(3 \times 5) = 15$ (d) Magnesium $(2 \times 3 \times 2) = 12$ (e) Calcium $(1 \times 5 \times 4) = 20$ (f) Sodium $(6 \times 3) = 18$ (g) Aluminium $(5 \times 4 \times 1 \times 3) = 60$ (h) Helium $(2 \times 1) = 2$ (i) Chlorine $(5 \times 6 \times 4 \times 2) = 240$

2	6	1	4	3	5
6	2	3	1	5	4
4	3	2	5	6	1
5	4	6	2	1	3
1	5	4	3	2	6
3	1	5	6	4	2

(f) Nitrogen $(4 \times 3) = 7$ (g) Lithium $(3 \times 1) = 3$ (h) Sulphur $(6 \times 4 \times 5 \times 1) = 16$ (i) Krypton $(3 \times 2 \times 6) = 36$

Solution Senders of Chemistry Musing

Set - 64

- Samara Nandi, West Bengal

Set - 65

- K. Krishnamurthi, Andhra Pradesh
- Amar Pramanik, West Bengal

Solution Senders of Puzzle Corner

- Anand Reddy, Tamil Nadu
- Krishna Kumar, Haryana

Class XI

Be **JEE****READY** with exclusive and brain storming MCQs

Practicing these MCQs helps to strengthen your concepts and give you extra edge in your JEE preparation

- The number of β -particles emitted during the change ${}_Z^aX \longrightarrow {}_d^bY$ is
 (a) $\frac{a-b}{4}$ (b) $d + \left(\frac{a-b}{2}\right) + c$
 (c) $d + \left(\frac{c-b}{2}\right) - a$ (d) $d + \left(\frac{a-b}{2}\right) - c$
- On heating 5×10^{-3} eq. of $\text{CaCl}_2 \cdot x\text{H}_2\text{O}$, 0.18 g of water is obtained, what is the value of x ?
 (a) 5 (b) 4 (c) 3 (d) 2
- A sample of AgCl was treated with 5.00 mL of 1.5 M Na_2CO_3 solution to give Ag_2CO_3 . The remaining solution contained 0.0026 g of Cl^- per litre. Calculate the solubility product of AgCl ($K_{sp} \text{Ag}_2\text{CO}_3 = 8.2 \times 10^{-12}$)
 (a) 7.32×10^{-5} (b) 1.71×10^{-10}
 (c) 2.34×10^{-6} (d) 1.34×10^{-10}
- Consider both these equilibrium to be established simultaneously in a closed container.
 $\text{X}_{(g)} \rightleftharpoons \text{Y}_{(g)} + 2\text{Z}_{(g)}$; $\text{A}_{(g)} \rightleftharpoons \text{Y}_{(g)} + \text{B}_{(g)}$
 At equilibrium, pressure of Z and B were found to be same and sum of pressure of Z and B is 10 atm more than that of Y. Find ratio of standard Gibbs energy of two reactions.
 (a) 20 (b) $2.303 \log_{10} 20$
 (c) $\log_{10} \sqrt[3]{144}$ (d) $\frac{3 + \log 12}{2 + \log 6}$
- Which of the following doesn't give anti-Markownikoff's product?
 (a) $\text{R}_3\text{N}-\text{CH}=\text{CH}_2 \xrightarrow{\text{HBr}}$
 (b) $\text{CH}_3-\text{CH}=\text{CH}_2 \xrightarrow[\text{Peroxide}]{\text{HBr}}$
 (c) $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3 \xrightarrow[\text{Peroxide}]{\text{HBr}}$
 (d) $\text{CH}_3-\text{CH}=\text{CH}_2 \xrightarrow[\text{Peroxide}]{\text{CCl}_4/\text{Br}}$
- A Red hot coke $\xrightarrow{\text{CO}}$ $\xrightarrow{\text{Cl}_2}$ C $\xrightarrow{\text{H}_2\text{O}}$ $2\text{HCl} + \text{A}$.
 The compounds A and C are
 (a) $\text{CO}_2, \text{COCl}_2$ (b) CO, COCl_2
 (c) C, CO_2 (d) CO_2, CO
- 1 mole of CO_2 gas at 300 K is expanded under reversible adiabatic condition such that its volume becomes 27 times. What is work done? (Given $\gamma = 1.33$ and $C_V = 25.08 \text{ J mol}^{-1} \text{ K}^{-1}$ for CO_2)
 (a) -7.524 kJ (b) -5.016 kJ
 (c) -3.762 kJ (d) -10.032 kJ
- Match the column-I with column-II and choose the correct option.

Column-I (element/elements)	Column-II (group number)
(A) An element whose fourth shell contains two p-electrons	(p) 8 th group
(B) An element whose valence shell contains one unpaired p-electron	(q) 12 th group
(C) An element which receives last electron in $(n-1)$ d-subshell	(r) 14 th group

- (D) An element with the ground state electronic configuration $[\text{Ar}]4s^23d^{10}$

A B C D

- (a) p q, r s q
(b) r p, q q s
(c) r s p, q q
(d) q p p, s r

9. Sodium fusion extract of an organic compound gives blood red colour with $\text{FeSO}_4/\text{conc. H}_2\text{SO}_4$ on heating. Fresh extract of the same compound gives black precipitate when mixed with $(\text{CH}_3\text{COO})_2\text{Pb}$ and yellow precipitate when treated with AgNO_3 solution. Then the organic compound may also contain
- (a) N, Cl (b) N, I
(c) N, S, I (d) S, I

10. $\text{CaCl}_2 + \text{H}_2\text{SO}_4 \xrightarrow[\text{-HCl}]{\text{Crystallisation}} \text{CaSO}_4 \cdot 2\text{H}_2\text{O} \xrightarrow{(p)} \xrightarrow{(q) \rightarrow 393 \text{ K}} (r)$

Which of the following option describes p, q, r correctly?

- | (p) | (q) | (r) |
|--------------------------------------|---|-----------------|
| (a) Heat at 393 K | $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ | CaSO_4 |
| (b) Heat below 393K at high pressure | $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ | CaSO_4 |
| (c) Cool | $\text{CaSO}_4 \cdot \text{H}_2\text{O}$ | CaSO_4 |
| (d) Heat at 393 K | CaSO_4 | CaSO_4 |

11. The following process has been used to obtain iodine:
- $$\text{NaI} + \text{AgNO}_3 \longrightarrow \text{AgI} + \text{NaNO}_3$$
- $$2\text{AgI} + \text{Fe} \longrightarrow \text{FeI}_2 + 2\text{Ag}$$
- $$2\text{FeI}_2 + 3\text{Cl}_2 \longrightarrow 2\text{FeCl}_3 + 2\text{I}_2$$

How many grams of AgNO_3 are required in the first step for every 254 kg I_2 produced in the third step?

- (a) 340 kg (b) 85 kg (c) 68 kg (d) 380 kg

12. $\text{C}_6\text{H}_5\text{Br} \xrightarrow{\text{KMnO}_4} \text{C}_6\text{H}_4\text{BrO}_2 \xrightarrow[\text{Fe}]{\text{Br}_2} \text{C}_6\text{H}_3\text{BrO}_4$ (C)
If (C) has only one possible structure (one-product only) then deduce structure of (A).



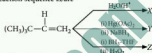
13. Select the correct statement.

- (a) The order of Xe-F bond length in various fluorides of xenon is $\text{XeF}_2 < \text{XeF}_4 < \text{XeF}_6$
(b) PH_3 can undergo sp^3d hybridisation to have octahedral geometry.

- (c) Dipole moment of CH_3F is greater than that of CH_3Cl

- (d) Increasing strength of hydrogen bonding is $\text{Cl}-\text{H} \cdots \text{Cl} < \text{N}-\text{H} \cdots \text{N} < \text{O}-\text{H} \cdots \text{O} < \text{F}-\text{H} \cdots \text{F}$

14. The correct statement(s) about the following reaction sequence is/are



- (a) X and Y are optically active whereas Z is optically inactive.
(b) Y and Z are optically active whereas X is optically inactive.
(c) X and Z are optically inactive whereas Y is optically active.
(d) Y and Z are optically inactive whereas X is optically active.

15. A balloon of diameter 20 m weighs 100 kg. Calculate its payload, if it is filled with He at 1.0 atm and 27°C . Density of air is 1.2 kg m^{-3} . ($R = 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$)

- (a) $502.8 \times 10^4 \text{ g}$ (b) $78.13 \times 10^4 \text{ g}$
(c) $424.75 \times 10^4 \text{ g}$ (d) $821.42 \times 10^4 \text{ g}$

SOLUTIONS

1. (c) $cX \longrightarrow \frac{1}{2}Y + m \frac{1}{2}He + n \frac{1}{2}e$
 $\therefore c = b + 4m \dots (i)$ and $a = d + 2m - n \dots (ii)$

From (i) and (ii), $n = d + \left(\frac{c-b}{2}\right) - a$

2. (b): Eq. wt. of $\text{CaCl}_2 \cdot x\text{H}_2\text{O} = \frac{111 + 18x}{2} = 55.5 + 9x$
 $\therefore 5 \times 10^{-3} \text{ eq. of } \text{CaCl}_2 \cdot x\text{H}_2\text{O}$
 $= 5 \times 10^{-3} \times (55.5 + 9x) \text{ g of } \text{CaCl}_2 \cdot x\text{H}_2\text{O}$

\therefore Amount of water obtained

$$= \frac{18x}{111 + 18x} \times 5 \times 10^{-3} \times (55.5 + 9x) = 9x \times 5 \times 10^{-3}$$

$$\therefore 9x \times 5 \times 10^{-3} = 0.18 \text{ or } x = \frac{0.18}{9 \times 5} \times 10^3 = 4$$

3. (b): Millimole of $\text{Na}_2\text{CO}_3 = 5 \times 1.5 = 7.5$



$$\begin{array}{cccc} t=0 & 7.5 & 0 & 0 \\ t_{\text{eqm}} & (7.5-x) & 2x & x \end{array}$$

$$\text{Given } [\text{Cl}^-] = 0.0026 \text{ g/L} = \frac{0.0026}{35.5} \text{ mol/L}$$

$$= 7.32 \times 10^{-5} \text{ mol/L}$$

Concentration of Cl^- ion formed = $\frac{2x}{5}$

$$\therefore \frac{2x}{5} = 7.32 \times 10^{-5}$$

or $x = 1.83 \times 10^{-4}$ millimole

∴ Millimole of Na_2CO_3 left in 5 mL = $7.5 - x$
 $= 7.5 - 1.83 \times 10^{-4} = 7.5$

$$\therefore [\text{CO}_3^{2-}] = \frac{7.5}{5} = 1.5$$

Now For Ag_2CO_3 , $K_{sp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}]$

$$\therefore [\text{Ag}^+]^2 = \frac{8.2 \times 10^{-12}}{1.5} = 5.46 \times 10^{-12}$$

$$\therefore [\text{Ag}^+] = 2.34 \times 10^{-6}$$

Now For AgCl , $K_{sp} = [\text{Ag}^+][\text{Cl}^-]$
 $= 2.34 \times 10^{-6} \times 7.32 \times 10^{-5}$
 $= 1.71 \times 10^{-10}$

4. (d) : $X_{(g)} \rightleftharpoons Y_{(g)} + 2Z_{(g)}$; $A_{(g)} \rightleftharpoons Y_{(g)} + B_{(g)}$
 $n_{\text{eq}} \quad (a+b) \quad 2a \quad (a+b) \quad (b)$

$$\text{Given : } p_Z = p_B \Rightarrow 2a = b$$

$$\text{and } p_Z + p_B = p_T + 10 \Rightarrow (2a + b) = (a + b) + 10$$

$$a = 10 \text{ atm and } b = 20 \text{ atm}$$

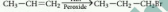
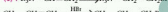
$$K_{p1} = (a + b) (2a)^2 = (30) (400) = 12000$$

$$K_{p2} = (a + b) (b) = (30) (20) = 600$$

$$\Delta G = -RT \ln K$$

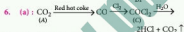
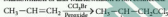
$$\frac{\Delta G_1}{\Delta G_2} = \frac{\ln K_1}{\ln K_2} = \frac{\log 12000}{\log 600} = \frac{3 + \log 12}{2 + \log 6}$$

5. (c) : $R_3\text{N}^+ - \text{CH} = \text{CH}_2 \xrightarrow{\text{HBr}} R_3\text{N}^+ - \text{CH}_2 - \text{CH}_2\text{Br}$



Symmetrical alkene

Markownikoff or anti-Markownikoff is not connected.



7. (b) : $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$
 $300 \times V_1^{0.5} = T_2 \times (27 V_1)^{0.5} \Rightarrow T_2 = 100 \text{ K}$
 $\Delta U = q + W$

For reversible adiabatic process, $q = 0$

Thus, $\Delta U = W \Rightarrow W = nC_V \Delta T$

$$W = 1 \times 25.08 \times (100 - 300) = -5.016 \text{ kJ}$$

8. (c)

9. (c) : Blood red colour with $\text{FeSO}_4/\text{conc. H}_2\text{SO}_4$ by sodium fusion extract

\Rightarrow the compound has both N and S

Black precipitate with lead acetate by sodium fusion extract

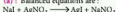
\Rightarrow the compound has S.

Yellow precipitate with AgNO_3 by Sodium fusion extract

\Rightarrow the compound has I.

10. (a)

11. (a) : Balanced equations are :



∴ Mole of I_2 = Mole of FeI_2

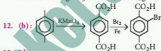
$$= \left(\frac{\text{Mole of AgI}}{2} \right) = \left(\frac{\text{Mole of AgNO}_3}{2} \right)$$

$$\frac{254 \times 10^3}{254} = \frac{\text{Mole of AgNO}_3}{2}$$

$$\Rightarrow 2 \times 10^3 = \text{Mole of AgNO}_3$$

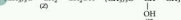
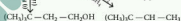
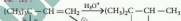
$$= \frac{\text{Mass of AgNO}_3}{\text{Molar mass of AgNO}_3}$$

$$\therefore \text{Mass of AgNO}_3 = 170 \times (2 \times 10^3) \text{ g} = 340 \text{ kg}$$



13. (d)

14. (c) :



15. (c) : Weight of balloon = $100 \text{ kg} = 10 \times 10^4 \text{ g}$

$$\text{Volume of balloon} = \frac{4}{3} \pi r^3 = \frac{4}{3} \times \frac{22}{7} \times \left(\frac{20}{2} \times 100 \right)^3$$

$$= 4190 \times 10^6 \text{ cm}^3 = 4190 \times 10^3 \text{ L}$$

Weight of gas (He) in balloon

$$= \frac{PV}{RT} = \frac{1 \times 4190 \times 10^3 \times 4}{0.0821 \times 300} = 68.05 \times 10^4 \text{ g}$$

$$\left(\because PV = \frac{w}{M} RT \right)$$

∴ Total weight of gas and balloon

$$= 68.05 \times 10^4 + 10 \times 10^4 = 78.05 \times 10^4 \text{ g}$$

$$\text{Weight of air displaced} = \frac{1.2 \times 4190 \times 10^6}{10^3}$$

$$= 502.8 \times 10^4 \text{ g}$$

∴ Payload = wt. of air displaced - (wt. of balloon + wt. of gas)

$$\therefore \text{Payload} = 502.8 \times 10^4 - 78.05 \times 10^4$$

$$= 424.75 \times 10^4 \text{ g}$$



CLASS XI

CBSE DRILL



Chapterwise practice questions for CBSE Exams as per the latest pattern and marking scheme issued by CBSE for the academic session 2018-19.

GENERAL INSTRUCTIONS

- All questions are compulsory.
- Section A: Q.no. 1 to 5 are very short answer questions and carry 1 mark each.
- Section B: Q.no. 6 to 12 are short answer questions and carry 2 marks each.
- Section C: Q.no. 13 to 24 are also short answer questions and carry 3 marks each.
- Section D: Q.no. 25 to 27 are long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of one mark, two questions of two marks, four questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- Use log tables if necessary, use of calculators is not allowed.

Time Allowed : 3 hours

Maximum Marks : 70

Hydrocarbons | Environmental Chemistry

SECTION-A

- The name 2-ethylbutane is incorrect. Write the correct name.
- What would have happened if the greenhouse gases were totally missing in the earth's atmosphere? Discuss.
- Sodium salt of which acid will be needed for the preparation of propane? Write chemical equation for the reaction.
- Alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write structure and IUPAC name of 'A'.

OR

Explain why *p*-xylene has higher melting point than the corresponding *ortho* or *meta* isomers.

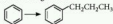
- What type of pollution is seen in stratosphere?

OR

What are the harmful effects of NO_2 on human health?

SECTION-B

- Write structures of all the alkenes which on hydrogenation give 2-methylbutane.
- Suggest a method to synthesize the product from the indicated starting material.



OR

- The hydrogenation of an unknown compound A over Pd/C gives butane whereas that over Pd/BaSO₄ gives B. Ozonolysis (with reductive work up with Zn/H₂O) of B gives ethanal. What are A and B?
- Why are the compounds of nitrogen and phosphorus considered as pollutants?
 - Why does the rain water normally have a pH of about 5.6? When does it becomes acid rain?

10. Describe simple chemical tests that would distinguish between :

- (i) pent-2-yne and *n*-pentane
(ii) pent-1-yne and pent-1-ene.

11. What happens when (give equations only)

- (i) Ethyl magnesium bromide is treated with heavy water?
(ii) Methyl magnesium chloride reacts with ethanoic acid?

OR

Write chemical equations for combustion reaction of the following hydrocarbons:

- (i) Butane (ii) Pentene
(iii) Hexyne (iv) Toluene

12. Statues and monuments all over the world are affected by acid rain. How?

SECTION-C

13. How would you carry out the following conversions?

- (i) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}=\text{CH}_2 \longrightarrow \text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{OH}$
(ii) $\text{Br}_2\text{CH}-\text{CHBr}_2 \longrightarrow \text{HC}\equiv\text{CH}$
(iii) $\text{H}_3\text{C}-\text{C}\equiv\text{CH} \longrightarrow \text{H}_3\text{CCOCH}_3$

14. What is photochemical smog and what are its harmful effects?

15. Give the names and structures of the reactive intermediates formed in case of nitration, sulphonation and Friedel-Crafts acylation.

OR

How will you convert benzene into

- (i) *p*-Bromonitrobenzene
(ii) *m*-Chloronitrobenzene
(iii) Acetophenone?

16. Draw all possible isomers for the compound with molecular formula C_2BrClFI . Label them as (*E*) or (*Z*) isomer.

17. What is green chemistry? How will it help to reduce environmental pollution?

OR

What are the international standards for level of the following pollutants in drinking water? What are the harmful effects caused by them?

- (a) Fluoride (b) Lead (c) Nitrate

18. Account for the following :

- (i) The boiling points of hydrocarbons decrease with increase in branching.

(ii) Hydrocarbons with odd number of carbon atoms have a melting point lower than expected.

(iii) Boiling point of *n*-pentane is greater than that of *neo*-pentane but melting point of *neo*-pentane is greater than that of *n*-pentane.

19. Answer the following :

- (i) Give two agricultural practices that contribute the most to land pollution.
(ii) How does improper management of industrial and domestic waste contribute to pollution?

20. (i) Draw the *cis* and *trans* structures of hex-2-ene. Which isomer will have higher boiling point and why?

(ii) Arrange the following in increasing order of their release of energy on combustion :



OR

Complete the following reactions :

- (i) $\text{HC}\equiv\text{CH} \xrightarrow{\text{NaNH}_2, \text{CH}_3\text{Br}} \text{A}$
(ii) $\text{HC}\equiv\text{CH} \xrightarrow{\text{HgSO}_4/\text{H}^+, \text{H}_2\text{SO}_4} \text{B}$
(iii) $\text{CH}_3\text{C}\equiv\text{CH} + \text{H}_2 \xrightarrow{\text{Pt}/\text{Pd}/\text{Ni}} \text{C} \xrightarrow{\text{H}_2} \text{D}$

21. (i) What is siltation?

(ii) What do you understand by soil pollution? List major soil pollutants and their sources.

22. (i) Why are some gases greenhouse gases and some are not?

(ii) What are polar stratospheric clouds (PSCs)?

OR

(i) Carbon monoxide gas is more dangerous than carbon dioxide gas. Why?

(ii) Do you observe any soil pollution in your neighbourhood? What efforts will you make for controlling the soil pollution?

23. A conjugated alkadiene having molecular formula $\text{C}_{13}\text{H}_{22}$ on ozonolysis yielded ethyl methyl ketone and cyclohexanecarbaldehyde. Identify the diene, write its structural formula and give its IUPAC name.

24. Write the structures of various carbocations that can be obtained from 2-methylbutane. Arrange these carbocations in order of increasing stability.

SECTION-D

25. (i) What are the necessary conditions for any compound to show aromaticity?
 (ii) How and under what conditions, does (a) chlorine, (b) nitric acid, react with benzene?

OR

Answer the following:

- (i) A hydrocarbon containing two double bonds on reductive ozonolysis gave ethanal, glyoxal and propanone. Predict the structure of the hydrocarbon and give its IUPAC name.
 (ii) The hydrocarbon A adds one mole of hydrogen in the presence of a platinum catalyst to form *n*-hexane. When A is oxidized vigorously with KMnO_4 , a single carboxylic acid containing three carbon atoms is isolated. Give the structure of A and explain the reaction.
 (iii) Suggest a method (a flow sheet) to separate a mixture of ethane, ethene and ethyne.

26. Answer the following:

- (i) What is meant by COD (chemical oxygen demand)? How is it measured?
 (ii) What is Minamata disease?
 (iii) How can domestic waste be used as manure?

OR

Answer the following:


- (i) What are the major causes of water pollution? Explain.
 (ii) Have you ever observed any water pollution in your area? What measures would you suggest to control it?

27. (a) What alkyne would you start with and what reagents would you use to prepare:

- (i) *cis*-but-2-ene (ii) *trans*-pent-2-ene
 (b) When 3,3-dimethylbutan-2-ol is treated with concentrated HI , a rearrangement occurs. Name the alkyl iodide formed showing the steps of the reaction.
 (c) Out of benzene, *m*-dinitrobenzene and toluene which will undergo nitration most easily and why?

OR

- (i) Write chemical reactions to illustrate the Kolbe's reaction
 (ii) Name the compound that will be required to obtain butane using Kolbe's electrolysis process.

- (iii) Explain why  is not aromatic.

- (iv) In the presence of peroxide addition of HBr to propene takes place according to anti-Markovnikov's rule but peroxide effect is not seen in the case of HCl and HI . Explain.
 (v) How will you convert ethyne to benzene?

SOLUTIONS



1. If the greenhouse gases were missing from the earth's atmosphere, temperature of the earth will fall. That will adversely affect the water and agricultural cycles. Ultimately, we may have the beginning of the ice age on the earth.

3. Butanoic acid,



OR

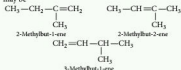
The *para* isomer has a more symmetrical structure, allowing it to fit better into the crystal lattice than the *ortho* or *meta* isomer.

5. Most atmospheric ozone is found in stratosphere, therefore mainly the depletion of ozone layer is the pollution effect seen in stratosphere.

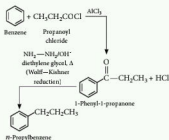
OR

Acute exposure to NO_2 can cause lung irritation and can lead to acute respiratory diseases in children. NO_2 may also cause bronchitis.

6. An alkene contains one double bond in its molecule. 2-Methylbutane consists of a four carbon chain. So, the alkenes which on hydrogenation give 2-methylbutane may be

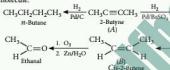


7. A Friedel-Crafts acylation reaction followed by reduction of the carbonyl group to a methylene group is the best way to introduce unbranched alkyl groups onto an aromatic ring.



OR

The hydrogenation of A over Pd/C gives butane, indicating that compound A must have four carbon atoms. The reaction with Pd/BaSO₄ suggests that A is an alkyne and thus B must be a cis-alkene corresponding to alkyne A. Since B gives only ethanal, the double bond must be symmetrically located in the centre of the molecule.



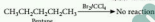
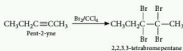
8. Large amounts of nitrogen and phosphorus in rivers and lakes result in the overgrowth of algae in water. When the algae die, they are decomposed by bacteria. This process of decay consumes the oxygen dissolved in the water which reduces the amount of oxygen available. As a result of lack of oxygen, other forms of aquatic life such as fish and plants may die.

9. Normally rain water has a pH of about 5.6 due to the dissolution of CO₂ of the atmosphere into it:

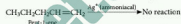


The oxides of nitrogen and sulphur undergo many photochemical reactions in atmosphere and form HNO₃ and H₂SO₄ acid. Due to these acids the pH of rain water falls below 5.6 and it becomes acid rain.

10. (i) Pent-2-yne decolourises the colour of bromine in carbon tetrachloride, whereas *n*-pentane does not.



(ii) Pent-1-yne gives a white precipitate with ammoniacal silver nitrate solution, whereas pent-1-ene does not.



mtg

The only thing you NEED for excellence in Class -11



HIGHLIGHTS

- Important Facts/Formulae & Comprehensive Theory
- Practice Questions, NCERT & Exemplar Problems
- HOTS Questions
- Previous Years' Questions of KVS, NCT, etc.
- Answers as per CBSE Marking Scheme
- 10 Practice Papers

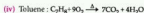
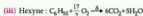
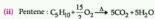
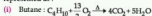
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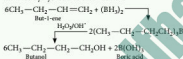
OR

Upon combustion, any hydrocarbon produces CO_2 and H_2O . For the given hydrocarbons the reactions may be represented as :

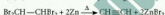


12. Both marble and limestone (CaCO_3), of which many statues and monuments are made, react with sulphuric acid (of acid rain) to form calcium sulphate, which is water soluble and dissolves in rain water. $\text{CaCO}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CaSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$. As a result, the marble becomes pitted and weakened mechanically and statues and monuments are getting discoloured and lustreless.

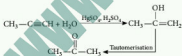
13. (i) The net anti Markownikoff addition of one molecule of water to a molecule of an alkene can be achieved by hydroboration oxidation.



(iii) Ethyne ($\text{CH}\equiv\text{CH}$) can be obtained from 1, 1, 2, 2-tetrabromoethane by heating it with zinc.



(iii) Alkynes add one molecule of water in the presence of H_2SO_4 and HgSO_4 to give carbonyl compounds.



14. Photochemical smog : It is a mixture of gases formed as a result of photochemical reaction between NO_x and hydrocarbons in the presence of sunlight. It comprises mainly of ozone, peroxyacetyl nitrates (PAN) and aldehydes (RCHO).

It is also called Los Angeles smog. It is formed around mid-day in summer months. It does not involve any

smoke or fog. It is oxidising in nature.

The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate (PAN).

Harmful effects of photochemical smog :

(i) Aldehydes and PAN components of smog cause irritation of eyes and affect the respiratory tract of human beings.

(ii) Ozone causes cracks in rubber materials and is also harmful to fabrics.

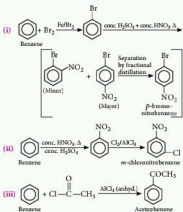
(iii) Ozone and nitric oxide irritate the nose and throat and their high concentration causes headache, chest pain and dryness of throat.

15. Reaction Reactive intermediate/name

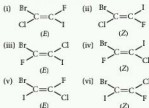
Nitration NO_2^+ (nitronium cation)

Sulphonation SO_3 $\left(\begin{array}{c} \text{O} \\ \parallel \\ \text{S} \\ \parallel \\ \text{O} \end{array} \right)$
Sulphur trioxide

Friedel-Crafts acylation CH_3CO^+ $\left(\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}} \right)$
Acylium cation

OR

16. There are six isomers.



17. Green chemistry emphasises that synthesis, whether in the laboratory or in the industry, should be so designed so as to cause zero or minimum environmental pollution.

Green chemistry aims at:

- Use of environment friendly medium for the reaction.
- Use of methods that completely convert the reactants to products such that there are no harmful side-products formed.

This is arrived at by working out optimum conditions for synthesis such that there are no harmful side-products formed. Thus, green chemistry produces products which have no adverse impact on the environment.

OR

(a) **Fluoride**: The international standards for level of fluoride is 1 ppm/1 mg dm⁻³. Its deficiency causes tooth decay and its concentration above 2 ppm causes brown mottling of teeth. Higher concentrations of fluoride are poisonous harmful to teeth and bones at levels above 10 ppm.

(b) **Lead**: The international standards for level of lead is 50 ppb. Excessive lead causes kidney dysfunction, anaemia, nervous disorder, brain damage etc.

(c) **Nitrate**: The international standards for level of nitrate is 50 ppm. Excessive nitrate in drinking water causes methemoglobinemia (blue baby syndrome).

18. (i) Branched chain alkanes have lower boiling points than their straight chain isomers, and as branching increases, the boiling point decreases still further. The explanation is that increased branching gives the molecule a more spherical shape and reduces the extent of contact between neighbouring molecules. Consequently, the attractive forces are reduced and the boiling point decreases.

(ii) Hydrocarbons with odd number of carbon atoms have lesser melting point than expected. This is because,

even number of carbon atoms are more symmetrical than those containing odd numbers of carbon atoms and hence pack closely in the crystal lattice. In other words, van der Waals' forces of attraction are much stronger in hydrocarbons having even number of carbon atoms than those having odd number of carbon atoms.

(iii) In *n*-pentane, due to large surface area, the extent of contact between neighbouring molecules is more. Therefore, the attractive forces are more and the boiling point increases. But the melting point of *neo*-pentane is greater than that of *n*-pentane because *neo*-pentane has a highly symmetrical structure and reduced surface area. Therefore, it is packed in the crystal systems more closely than *n*-pentane. So, more energy is required to break the *neo*-pentane lattice than the *n*-pentane. Hence, *neo*-pentane has a higher melting point than *n*-pentane.

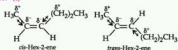
19. (i) (a) Use of fertilizer.

(b) Use of pesticides, insecticides during crop protection exercise.

(ii) Industrial waste can be biodegradable as well as non-biodegradable. Biodegradable wastes are generated by cotton mills, paper mills and textile industries. Non-biodegradable wastes are generated by thermal power plants and by industries manufacturing aluminium. If they are not disposed of in a proper manner, then they become a serious threat to the environment.

Domestic waste includes paper pieces, glass, food wastes, etc. Some of these are non-biodegradable and pollute the environment and also some of them emit poisonous gases and pathogenic bacteria which are disease causing.

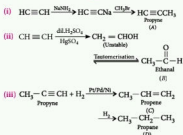
20. (i)



Of the given isomers, the *cis* isomer has a higher boiling point. This difference arises due to higher dipole moment of the *cis* isomer which introduces a somewhat ionic character in the compound. In the *trans* isomer, the dipoles cancel each other resulting in a small dipole moment as the case may be.

(ii) Large the number of carbon atoms having maximum hydrogens (i.e., CH₃ groups) greater is the heat of combustion. Thus, the increasing order of heat of combustion: (c) < (d) < (a) < (b)

OR



21. (i) Siltation is the mixing of small fragments of rocks and loose soil particles with moving water bodies.

(ii) **Soil pollution** : Soil pollution is the addition of such chemical substances (in an indefinite proportion) which deteriorates the quality, texture and mineral content of the soil and disturbs the biological balance of the organisms in it and has lethal effect on the plant growth.

Some major soil pollutants and their sources are :

Pollutants	Major sources
Industrial wastes	Waste products from paper, sugar, chemical industries dumped into the soil.
Agricultural wastes	Chemicals such as fertilizers, pesticides, etc. used for killing insects, fungi and weeds.
Soil conditioners	Used to protect soil fertility but contains several toxic metals like Pb, As, Hg, Cd, etc.
Farm wastes	Wet slurry, faecal wastes are seeped into the soil.
Radioactive pollutants	Dumping of nuclear wastes into the soil.

22. (i) Greenhouse gases allow the passage of incoming solar short wavelength radiation but absorb the longer wavelength infrared radiation from the earth. Therefore, in order to act as a greenhouse agent, the gas should have covalent bonds with the same vibration frequency as the frequency of the infrared radiation.

Thus the gases which can trap infrared radiation given by the sun to produce greenhouse effect leading to heating up the environment can act as greenhouse gases such CO_2 , O_3 etc.

(ii) The special type of clouds present over Antarctica in winters are called polar stratospheric clouds.

They are of two types :

Type I clouds contain some solidified nitric acid trihydrate ($\text{HNO}_3 \cdot 3\text{H}_2\text{O}$) formed at about -77°C .

Type II clouds contain some ice, formed at about -85°C . These clouds play an important role in ozone depletion.

OR

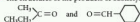
(i) Carbon monoxide is a colourless, odourless gas which has the tendency to bind to haemoglobin, the oxygen carrying molecule in blood and form a complex called carboxyhaemoglobin. This complex is 300 times more stable than oxyhaemoglobin complex. When the concentration of carboxyhaemoglobin reaches about 3-4 per cent, the oxygen carrying capacity of blood is greatly reduced. This oxygen deficiency, results into headache, weak eyesight, nervousness and cardiovascular disorder and therefore, if once formed can seriously hamper the body and may cause death. That is why CO is said to be more dangerous than CO_2 .

(ii) Yes. Insecticides, pesticides and even herbicides, which are generally used for the protection of crops causes soil pollution. Apart from this, the wastes generated from industries and general urban wastes containing garbage and waste material also pollute the soil.

Soil pollution can be controlled by :

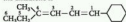
- using manures
- using bio-fertilizers
- using proper sewerage system
- salvage and recycling waste products.

23. The structures of the products of ozonolysis are :



Ethyl methyl ketone ($\text{C}_4\text{H}_8\text{O}$) Cyclohexanecarbaldehyde ($\text{C}_7\text{H}_{12}\text{O}$)

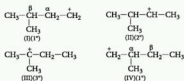
Since, the total number of carbon atoms of the two products is 11 (4 + 7) while the molecular formula of the conjugated diene is $\text{C}_{13}\text{H}_{22}$, therefore, the ozonolysis must have also produced one more two carbon product. Further, since the given compound ($\text{C}_{13}\text{H}_{22}$) is an alkadiene, the said two carbon products must be glyoxal, $(\text{CHO})_2$. On replacing the oxygen atoms from these three products by double bonds, the structure of the alkadiene is



1-Cyclohexyl-4-methylpenta-1,3-diene

24. 2-Methylbutane has four different sets of equivalent H-atoms.

Removal of H-atom from any of these equivalent sets gives four different carbocations as shown :



Stability of carbocation decreases in the order $3^\circ > 2^\circ > 1^\circ$. So, III (3° carbocation) is most stable followed by II (2° carbocation). Out of I and IV (both are 1° carbocations) I has a CH_3 group at β -carbon while IV has a CH_3 group at α -carbon. As +I effect decreases with distance, hence IV is more stable than I. Therefore, the overall stability of these four carbocations increases in the order: $\text{I} < \text{IV} < \text{II} < \text{III}$

25. (i) The necessary conditions for any compound to show aromaticity are:

(a) The compound should be planar and allow cyclic overlap of p -orbitals.

(b) Complete delocalization of π -electrons of the ring system.

(c) The compound must satisfy the Hückel's rule. The rule states that in a conjugated planar, cyclic system the number of delocalized π -electron is $(4n + 2)$ where $n = 0, 1, 2, 3, \dots$

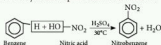
(ii) (a) If chlorine is passed through benzene at room temperature and in the presence of a catalyst, substitution takes place and chlorobenzene is obtained.



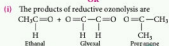
In the presence of ultraviolet light, addition of chlorine to benzene takes place and benzene hexachloride (BHC) is produced.



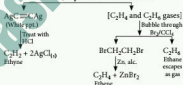
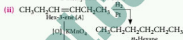
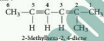
(b) When treated with nitric acid (in the presence of conc. sulphuric acid) at room temperature, nitrobenzene is formed by an electrophilic substitution reaction.



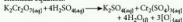
OR



The hydrocarbon can be written by removing oxygen atoms and writing double bonds between the carbonyl carbon atoms:



26. (i) The measurement of BOD takes a number of days (normally 5 days). Therefore, another quantity generally measured is called Chemical Oxygen Demand (COD). Chemical Oxygen Demand refers to the amount of oxygen, expressed in parts per million, consumed under specific conditions in the oxidation of the organic and oxidizable inorganic matter contained in industrial waste water. In order to measure COD, the given sample of water is treated with a known amount of an oxidising agent, generally $\text{K}_2\text{Cr}_2\text{O}_7$ in the presence of dilute H_2SO_4 . All the pollutants get oxidised including those which were resistant to microbial oxidation. The amount of $\text{K}_2\text{Cr}_2\text{O}_7$ left is found by back titration against a suitable reducing agent such as Mohr's salt (ferrous ammonium sulphate). The amount of $\text{K}_2\text{Cr}_2\text{O}_7$ utilised gives the amount of oxygen consumed and is calculated stoichiometrically with the help of following chemical equation:



The amount of oxygen consumed by the pollutants is expressed in ppm and is called COD of the given sample of water.

(ii) Minamata disease is methylmercury poisoning that occurred in humans who ingested fish and shellfish contaminated by methylmercury discharged in waste water from a chemical plant in May 1956. It was first officially 'discovered' in Minamata city, Japan.

Typical symptoms of Minamata disease are sensory disturbances, ataxia, dysarthria, constriction of the visual field and tremor.

(iii) Domestic waste consists mainly of two kinds of wastes - Biodegradable and non-biodegradable. If the biodegradable part is separated and collected from homes it can be dumped in land fills and converted to compost by the action of bacteria present in soil.

OR

(i) The major causes of water pollution may be enlisted as:

(a) **Pathogens** : Pathogens include bacteria and other organisms that enter water from domestic sewage and animal excreta. Human excreta contains bacteria such as *Escherichia coli* and *Streptococcus faecalis* which cause gastrointestinal diseases.

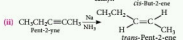
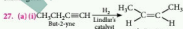
(b) **Organic wastes** : The other major water pollutant is organic matter such as leaves, grass, trash, etc. They pollute water as a consequence of run off. Excessive phytoplankton growth within water is also a cause of water pollution. These wastes are biodegradable.

(c) **Chemical pollutants** : Water soluble inorganic chemicals that include heavy metals such as cadmium, mercury, nickel, etc. constitute an important class of pollutants. These metals then can damage kidneys, central nervous system, liver, etc. Acids (like sulphuric acid) from mine drainage, salts from many different sources including raw salt that melt snow and ice in the colder climatic regions and sodium chloride, calcium chloride (as water soluble chemicals) are prominent chemical pollutants of water.

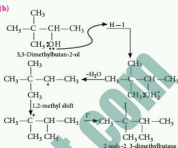
(ii) Yes. The water pollution can be controlled by :

Treatment of sewage can be done by removing impurities, by passing chlorine, by treatment with alum.

Treatment of industrial waste can be done by precipitating impurities, by photocatalysis, by using ion exchangers.



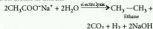
(b)



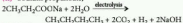
(c) $-\text{CH}_3$ group is electron releasing group while $-\text{NO}_2$ group is electron withdrawing group. Therefore, the electron density will be more in toluene than in benzene and the electron density in *m*-nitrobenzene will be less than in benzene. Therefore, the ease of nitration decreases in the order: toluene > benzene > *m*-dinitrobenzene.

OR

(i) **Kolbe's reaction** : In this reaction, an aqueous solution of sodium or potassium salt of carboxylic acid on electrolysis gives alkane having even number of carbon atoms at anode.



(ii) Sodium propanoate,



(iii) Cyclooctatetraene (COT) is not aromatic because of its non-planar tub-shaped structure. Although according to electron-count it seems to be an antiaromatic compound but, in fact it is non-aromatic compound.



(iv) Peroxide effect is seen only in case of addition of HBr and not in case of HCl and HI. This can be attributed to the fact that energy factors involved in various steps of free radical mechanism of peroxide effect favour the addition of HBr spontaneously but in HCl and HI, energy factor is not favourable.

(v) When acetylene is passed over red hot iron tube at 873 K, benzene is formed by cyclic polymerisation.



BRUSH UP

YOUR CONCEPTS

Class
XI

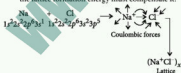
This specially designed column will help you to brush up your concepts by practicing questions. You can mail us your queries and doubts related to this topic at editor@mtg.in. The queries will be entertained by the author.*

CHEMICAL BONDING AND MOLECULAR STRUCTURE

- G.N. Lewis and Kossel separately gave the idea of octet formation by elements to attain stability like noble gases. Lewis gave the idea of valence shell acquiring shape of a cube on completing octet though not followed now.
- According to Lewis, covalent bond is formed by sharing of equal number of electrons between two electron deficient atoms. Later Langmuir used a hyphen (-) for a shared pair of electrons. Number of electrons shared by an atom is its covalency.

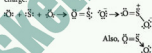


- According to Kossel, metals lose electrons while non-metals gain electrons to form cation and anion of charge corresponding to lost or gained electrons. These opposite ions join through coulombic or electrostatic forces and form ionic lattice. The number of electrons gained or lost by an atom is its electrovalency. Ionisation energy of metal should be low while electron gain enthalpy of non metal should be high to have net loss of energy. If not so, the lattice formation energy must compensate it.



- In coordinate bond, the shared pair of electrons comes from one atom called donor and the other

simply shares and is called acceptor. It causes formal charge.



Formal charge (F.C.) = Valence shell electrons of atom - unshared electrons - $\frac{1}{2}$ shared electrons.

$$\text{F.C. on right 'O'} = 6 - 6 - \frac{2}{2} = -1$$

- Bond order of a coordinate bond is 2 if the donor central atom can expand its valence shell and the acceptor atom can form a double bond otherwise bond order will be one.



N-atom cannot expand valence shell.

'-' bond has bond order one

- Polarity of a covalent bond depends upon the difference of electronegativities of bonded atoms :

Difference of E.N	% ionic character
2.0 - 3.2	Ionic bond
1.7 - 1.9	≈ 50% ionic character
0.1 - 1.6	Polar covalent bond.
- 100% ionic or 100% covalent bonds do not exist. Still, bond between two atoms of the same element is considered to be 100% covalent.
- Covalent character in electrovalent bond increases with increase of charge, increase of size of anion but decrease of size of cation. [Fajan rule]

*By R.C. Gouwer, having 45+ years of experience in teaching chemistry.

- Dipole moment (μ) of a polar bond = $(q \times d)$ Debye
 1 Debye = 10^{-18} esu-cm = 3.33×10^{-30} C-m
 % ionic character of bond

$$= \frac{\mu_{\text{observed}} \times 100}{\mu_{\text{for 100\% ionic character (theoretical)}}}$$

A molecule is called polar if $\mu(\text{net}) \neq 0$

- Molecules or ions having equal number of atoms and electrons are called isosters, e.g., N_2 , CO and CN^- .
- For the same peripheral atom, along a period bond angle decreases but dipole moment increases. For the same peripheral atom down a group bond angle and dipole moment both decreases.
- Resonance is hypothetical phenomenon where two or more structures, having same locations of atoms and same number of lone pairs and lone electrons, represent the same molecule.

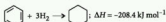
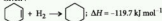
$$\text{Resonance stabilisation energy} = \Delta_{\text{reaction}} H_{\text{theoretical}} - \Delta_{\text{reaction}} H_{\text{exp}}$$

- The force of attraction between covalently bonded, positively behaving H-atom of a molecule with an electronegative atom (N, O, F) of the same molecule or (N, O, F) of different molecule is called hydrogen bond.
- Intermolecular hydrogen bond generally increases volume, boiling point and viscosity while decreases density. Intramolecular hydrogen bond decreases boiling point and makes compound steam volatile. Rigidity of silk, wool, sticky nature of honey, unexpected high b.pt. of water, etc., are due to hydrogen bonding.




MULTIPLE CHOICE QUESTIONS

- Which of the following is correct representation of sodium cation according to Lewis dot system?
 (a) :Na: (b) :Na^+
 (c) N^+ (d) All of these
- Which of the following is the main valence of element having atomic number 17?
 (a) 7 (b) -1 (c) 1 (d) -7
- According to Lewis when an atom complete its octet, the valence shell acquires
 (a) circular shape (b) spherical shape
 (c) cubic shape (d) star of 8 vertices
- Covalency of an element means
 (a) the number of electrons gained by its atom
 (b) the number of electrons lost by its atom
 (c) the number of electrons shared by its atom
 (d) the number of electrons donated by its atom.
- Which of the following is the correct dipole moment of HCl observed experimentally if the percentage ionic character is 17.48% and separation of H and Cl is 1.275×10^{-8} cm?
 (a) 1.0 D (b) 1.3 D (c) 1.07 D (d) 2.3 D
- What is the formal charge on $\overset{\text{I}}{\text{O}}$ in ozone molecule O_3 ?
 (a) Zero (b) +1 (c) -1 (d) -2
- Which of the following bond is the least ionic?
 (a) F—F (b) O—F
 (c) N—F (d) C—F
- Which of the following is the correct bond structure of molecule of nitric acid?
 (a) $\text{H}-\text{O}-\text{N}=\text{O}$ (b) $\text{H}-\text{O}-\text{N}=\text{O}$
 (c) $\text{H}-\text{O}-\text{N}=\text{O}$ (d) $\text{H}-\text{O}=\text{N}=\text{O}$
- Which of the following bond is the most ionic?
 (a) O—F (b) N—F
 (c) C—F (d) All equal
- What is the percentage ionic character of bond in LiH if the observed dipole moment is 1.964×10^{-29} C-m for the separation by 1.596 \AA ?
 (a) 67.8% (b) 76.8%
 (c) 68.7% (d) 86.7%
- What is the percentage covalent character in H—F molecule if μ observed is 1.78 D and bond distance is 0.92 \AA ?
 (a) 56.96% (b) 59.69%
 (c) 65.90% (d) 99.56%
- Select the one having the smallest bond angle among the following.
 (a) CH_4 (b) SiH_4 (c) NH_3 (d) H_2O
- Which of the following is not the canonical structure of acrolein, $\text{C}_3\text{H}_4\text{O}$?
 (a) $\text{CH}_2=\text{CH}-\text{CH}=\text{O}$
 (b) $\text{CH}_2=\text{CH}-\overset{+}{\text{C}}\text{H}-\overset{-}{\text{O}}$
 (c) $\overset{+}{\text{C}}\text{H}_2-\text{CH}=\text{CH}-\overset{-}{\text{O}}$
 (d) $\text{CH}_2=\text{CH}-\text{CH}=\overset{-}{\text{O}}$

14. Given :



The resonance energy of benzene is

- (a) 88.7 kJ mol⁻¹ (b) -318.1 kJ mol⁻¹
 (c) -150.7 kJ mol⁻¹ (d) none of these.
15. Which of the following has trigonal pyramidal shape?
 (a) NH₃ (b) PCl₃
 (c) H₂SO₄ (d) All of these
16. Which of the following has the same shape as SF₆?
 (a) SiF₄ (b) XeO₂F₂
 (c) NH₄⁺ (d) CCl₄
17. Which of the following is not expected to form intramolecular hydrogen bond?
- (a)  (b) 
- (c) CCl₃ - CH(OH)₂ (d) 

18. Which of the following is correct w.r.t. increasing boiling point?
 (a) H₂O < H₂S < H₂Se < H₂Te
 (b) H₂S < H₂O < H₂Se < H₂Te
 (c) H₂S < H₂Se < H₂O < H₂Te
 (d) H₂S < H₂Se < H₂Te < H₂O
19. What is the value of average bond order of P - O bond in PO₄³⁻?
 (a) 1.0 (b) 1.25 (c) 1.50 (d) 1.75
20. Methanol and ethanol are 100% miscible in water due to
 (a) covalent character
 (b) hydrogen bond formation
 (c) oxygen bond formation
 (d) breaking lattice of alcohols.

SOLUTIONS

1. (c)
 2. (c) : Valence is shown as the number of electrons gained or lost by the atom to complete the octet

without positive or negative sign.

At. No. = 17 ⇒ Electronic configuration

$$= 1s^2 2s^2 2p^6 3s^2 3p^5$$

It needs one electron to complete the octet.

3. (c) : According to Lewis, when an atom completes octet, the valence shell acquires cubic shape.

4. (c)

$$\begin{aligned} \mu & \text{ for 100\% ionic character} = q \times d \\ & = 4.8 \times 10^{-10} \text{ esu} \times 1.275 \times 10^{-8} \text{ cm} \\ & = 6.12 \times 10^{-18} \text{ esu} \cdot \text{cm} = 6.12 \text{ D} \end{aligned}$$

$$\% \text{ Ionic character} = \frac{\mu_{\text{(observed)}} \times 100}{\mu_{\text{(for 100\% ionic character)}}}$$

$$17.48 = \frac{\mu_{\text{(observed)}} \times 100}{6.12}$$

$$\mu_{\text{(observed)}} = \frac{17.48 \times 6.12}{100} = 1.07 \text{ D}$$

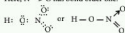
6. (a) : Formal charge = valence shell electrons - unshared electrons - $\frac{1}{2} \times$ shared electrons

$$= 6 - 4 - \frac{1}{2} \times 4 = 6 - 6 = 0$$

7. (a) : Bond between two atoms of the same element (fluorine), is least ionic as difference between electronegativities is zero.

8. (b) : N-atom can form at the most four covalent bonds.

Here, N → O has bond order one.



9. (c) : Difference of electronegativities of carbon (2.5) and fluorine (4.0) is the maximum among the given cases.

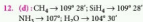
10. (b) : $\mu(100\%) = q \times d = 1.602 \times 10^{-19} \text{ C} \times 1.596 \times 10^{-10} \text{ m} = 2.557 \times 10^{-29} \text{ C} \cdot \text{m}$

$$\begin{aligned} \% \text{ Ionic character} & = \frac{\mu_{\text{observed}} \times 100}{\mu_{100\%}} \\ & = \frac{1.964 \times 10^{-29}}{2.557 \times 10^{-29}} \times 100 = 76.8\% \end{aligned}$$

11. (b) : $\% \text{ Ionic character} = \frac{\mu_{\text{observed}} \times 100}{\mu_{100\%}}$

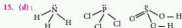
$$\begin{aligned} & = \frac{1.78 \times 10^{-18} \text{ esu} \cdot \text{cm}}{4.8 \times 10^{-10} \times 0.92 \times 10^{-8} \text{ esu} \cdot \text{cm}} \times 100 \\ & = 40.31\% \end{aligned}$$

$$\% \text{ Covalent character} = 100 - 40.31 = 59.69\%$$



13. (d)

14. (c) : Resonance energy = $\Delta_{\text{reaction}} H_{\text{theoretical}}$
 $- \Delta_{\text{reaction}} H_{\text{experimental}}$
 $= 3 \times (-119.7) - (-208.4)$
 $= -359.1 + 208.4 = -150.7 \text{ kJ mol}^{-1}$

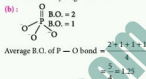


16. (b) : SF_4 and XeO_2F_2 both have distorted see-saw shape.

17. (d) : Groups at *p*-position on benzene ring do not form intramolecular hydrogen bond.

18. (d) : Among hydrides of sixteenth group, water has highest boiling point due to very strong intermolecular hydrogen bonds.

19. (b) :



Scientist of the Month



Har Gobind Khorana

(9 January, 1922 - 9 November, 2011)

Early Life and Education

Har Gobind Khorana was born in Raigarh, a village in Punjab, British India at the time, (now in Pakistan). The first four years of his education were provided under a tree, a spot that was, in effect, the only school in the village.

He attended D.A.V. High School in Multan, in West Punjab, with the assistance of scholarships, where he obtained a bachelor's degree in 1943 and a Master of Science degree in 1945.

He received his PhD in 1948 advised by Roger I. S. Beer. The following year, he pursued postdoctoral studies with Professor Vladimir Prelog at ETH Zurich in Switzerland. He worked for nearly a year on alkaloid chemistry in an unpaid position.

Contributions

- Ribonucleic acid (RNA) with two repeating units (UCUCUCU \rightarrow UCU CUC UCU), produced two alternating amino acids. This, combined with the Nirenberg and Leder experiment, showed that UCU genetically codes for serine and CUC codes for leucine. RNAs with three repeating units (UACUACUA \rightarrow UAC UAC UAC, or ACUACUACU, or CUA CUA CUA) produced three different strings of amino acids. RNAs with four repeating units including UAG, UAA, or UGA, produced only dipeptides and tripeptides thus revealing that UAG, UAA and UGA are stop codons.
- Their Nobel lecture was delivered on 12 December 1968. Khorana was the

first scientist to chemically synthesize oligonucleotides. This achievement, in the 1970s, was also the world's first synthetic gene; in later years, the process has become widespread.

- He extended the above to long DNA polymers using non-aqueous chemistry and assembled these into the first synthetic gene, using polymerase and ligase enzymes that link pieces of DNA together, as well as methods that anticipated the invention of polymerase chain reaction (PCR). These custom-designed pieces of artificial genes are widely used in biology labs for sequencing, cloning and engineering new plants and animals, and are integral to the expanding use of DNA analysis to understand gene-based human disease as well as human evolution.
- After the middle of the 1970s, his lab studied the biochemistry of bacteriorhodopsin, a membrane protein that converts light energy into chemical energy by creating a proton gradient. Later, his lab went on to study the structurally related visual pigment known as rhodopsin.

Honors

- He shared the 1968 Nobel Prize for Physiology or Medicine with Marshall W. Nirenberg and Robert W. Holley for research that showed the order of nucleotides in nucleic acids, which carry the genetic code of the cell and control the cell's synthesis of proteins.
- In addition to sharing the Nobel prize (while he was working at the University of Wisconsin in the U.S.), Khorana was elected as Foreign Member of the Royal Society (ForMemRS) in 1978.
- In 2007, the University of Wisconsin-Madison, the Government of India (DBT Department of Biotechnology), and the Indo-US Science and Technology Forum jointly created the Khorana Program. The mission of the Khorana Program is to build a seamless community of scientists, industrialists, and social entrepreneurs in the United States and India.
- In 2009, Khorana was hosted by the Khorana Program and honored at the 33rd Stenobock Symposium in Madison, Wisconsin.
- Other honours included the Louisa Gross Horwitz Prize from Columbia University and the Leuker Foundation Award for Basic Medical Research, both in 1969, the Willard Gibbs Medal of the Chicago section of the American Chemical Society, in 1974, the Gairdner Foundation Annual Award, in 1980 and the Paul Kayser International Award of Merit in Retina Research, in 1987.

Class XI

MONTHLY TUNE UP!

PRACTICE PROBLEMS

These practice problems enable you to self analyse your extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Performance analysis table given at the end will help you to check your readiness.

- The s-Block Elements
- The p-Block Elements (Group 13 & 14)

Total Marks : 120

Time Taken : 60 Min.

NEET / AIIMS

Only One Option Correct Type

- Which of the following statements about diborane is correct?
 - It contains two 3-centre-2-electron bonds.
 - The B atoms in it are sp^2 -hybridised.
 - The molecule is non-planar.
 - All B—H bond lengths are equal due to resonance.
 - I, II and III
 - II, III and IV
 - II and III
 - I and IV
- $B_2O_3 + 6NaOH \longrightarrow (X) + 3H_2O$
 - $B_2O_3 + 2NaOH \longrightarrow (Y) + H_2O$
 - (X) and (Y) are sodium borate and sodium metaborate
 - both are sodium borates
 - both are sodium metaborates
 - sodium metaborate and sodium borate.
- Sodium metal reacts with Al_2O_3 at high temperature to give a sodium compound X. X reacts with carbon dioxide in water to form Y. Y is
 - Na_2CO_3
 - Na_2O_2
 - $NaAlO_2$
 - Na_2O
- Aluminium is obtained by
 - reduction of Al_2O_3 with coke
 - electrolysis of Al_2O_3 dissolved in Na_3AlF_6 and CaF_2
 - reduction of Al_2O_3 with chromium
 - heating cryolite and alumina.
- $MgSO_4$ on reaction with NH_4OH and Na_2HPO_4 forms a white crystalline precipitate. What is its formula?
 - $Mg(NH_4)PO_4$
 - $Mg_3(PO_4)_2$
 - $MgCl_2 \cdot MgSO_4$
 - $MgSO_4$

- When a concentrated solution of ammonia is saturated with sodium chloride in the presence of pieces of dry ice, a water cloud is formed. This is due to
 - precipitation of sodium hydrogen carbonate from the reaction mixture
 - precipitation of ammonium carbonate
 - precipitation of ammonium hydrogen carbonate from the reaction mixture
 - precipitation of sodium carbonate from the reaction mixture.
- Which of the following is true for red lead?
 - It gives a red brown precipitate of PbO_2 when reacted with concentrated HNO_3 .
 - With H_2SO_4 it evolves H_2 .
 - It decomposes above $470^\circ C$ into PbO and O_2 .
 - Both (a) and (c).
- Which of the following pairs can be distinguished by the action of heat?
 - Na_2CO_3 and $CaCO_3$
 - $MgCl_2 \cdot 6H_2O$ and $CaCl_2 \cdot 6H_2O$
 - $Ca(NO_3)_2$ and $NaNO_3$
 - I and II
 - I, II and III
 - I and III
 - I only
- A compound named Sorel cement, is used in filling of gap between teeth. The compound is made of
 - $MgCl_2$, MgO , H_2O
 - MgO , $Mg(OH)_2$
 - CaO , SiO_2
 - $CaSO_4$, $CaCl_2$, H_2O
- Incorrect statement about Ge is
 - GeO_2 is amphoteric
 - $Ge(OH)_2$ is amphoteric
 - $GeCl_2$ is more stable than $GeCl_4$
 - Ge-Ge bond energy is lesser than that of Si - Si.

11. What are the products formed when an aqueous solution of magnesium bicarbonate is boiled?

- (a) MgCO_3 , H_2O , CO_2 (b) $\text{Mg}(\text{HCO}_3)_2$, H_2O
(c) $\text{Mg}(\text{OH})_2$, H_2O (d) Mg , CO_2 , H_2O

12. Which of the following statements are incorrect?

- (I) Graphite has such a high thermodynamic stability that diamond spontaneously changes into graphite in ordinary conditions.
(II) Graphite and diamond have equal thermodynamic stability.
(III) Graphite is thermodynamically more stable than diamond.
(IV) Diamond is thermodynamically more stable than graphite.
(a) II, IV (b) I, II and IV
(c) I, II and III (d) II, III, and IV

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion:** SiCl_4 forms $(\text{SiCl}_4)_2^{2+}$ while CCl_4 does not form $(\text{CCl}_4)_2^{2+}$.

Reason : Carbon shows a fixed covalency of 4 but silicon can expand its covalency from 4 to 6.

14. **Assertion:** Ether can extract LiCl from a mixture of LiCl , NaCl and KCl .

Reason : LiCl has covalent nature but NaCl and KCl are ionic compounds.

15. **Assertion :** In water, orthoboric acid behaves as a weak monobasic acid.

Reason : In water, orthoboric acid acts as a proton donor.

JEE MAIN / ADVANCED

Only One Option Correct Type

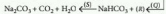
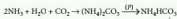
16. Consider the following abbreviations for hydrated alkali ions :

$X = [\text{Li}(\text{H}_2\text{O})_n]^+$, $Y = [\text{K}(\text{H}_2\text{O})_n]^+$, $Z = [\text{Cs}(\text{H}_2\text{O})_n]^+$

Which is the correct order of size of these hydrated alkali ions?

- (a) $Z > X > Y$ (b) $X = Y = Z$
(c) $X > Y > Z$ (d) $Z > Y > X$

17. The following flow diagram represents the manufacturing of sodium carbonate:



Which of the following options describes the underline reagents, product and reaction conditions?

- | (P) | (Q) | (R) | (S) |
|---------------------|---------------|------------------------|----------|
| (a) Carbon dioxide | NaCl | NH_4Cl | Heat |
| (b) Carbon dioxide | NaCl | NH_4Cl | Catalyst |
| (c) Higher temp. | NaCl | NH_4Cl | Heat |
| (d) Higher pressure | NaCl | NH_4Cl | Catalyst |

18. An inorganic compound (X) on hydrolysis produces a gas which on treatment with sodium followed by its reaction with ethyl chloride forms another compound (Y). Compound (Y) on heating with Pd catalyst gives pent - 2 - ene as major product. Hence, the inorganic compound (X) is
(a) TiCl_4 (b) BaCl_2 (c) SiCl_4 (d) MgCl_2

19. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ is correctly represented as

- (a) $2\text{NaBO}_2 \cdot \text{Na}_2\text{B}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$
(b) $\text{Na}_2[\text{B}_4\text{O}_7(\text{OH})_4] \cdot 8\text{H}_2\text{O}$
(c) $\text{Na}_2[\text{B}_4(\text{H}_2\text{O})_4\text{O}_7] \cdot 6\text{H}_2\text{O}$
(d) all of these.

More than One Options Correct Type

20. Which of the following statements is/are correct?

- (a) At normal temperature I A group metals adopt a body centred cubic type of lattice with a coordination number of eight.
(b) At very low temperature lithium forms a hexagonal close packed structure with a coordination number of 12.
(c) Lithium is softer than the other metals but is harder than lead.
(d) LiO_2 and NaO_2 are yellow but KO_2 is colourless.

21. Aqueous solution of KI dissolves I_2 to form KI_3 . Which of the following statements is/are true?

- (a) The solution contains K^{3+} and I^- ions.
(b) The solution contains K^+ and I_3^- ions.
(c) The solution is yellow in colour.
(d) In KI_3 , I_2 behaves as Lewis acid and I^- as Lewis base.

22. $\text{X} + \text{NH}_4\text{Cl} \longrightarrow \text{Y} + \text{NaCl} + \text{B}_2\text{O}_3 + \text{H}_2\text{O}$



Which of the following statements is/are correct about the above reactions?

- (a) Y has layered structure like graphite.
(b) A is a Lewis acid, exist as a dimer.
(c) Gas Z is base, excess Z on reaction with A at high temperature give Y.
(d) X has two tetrahedral and two triangular units.

23. Which of the following statements is/are correct regarding the compounds of carbon family elements?
- (a) Maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6.
- (b) The stability order of group-14 dihalides is $\text{SiX}_2 < \text{GeX}_2 < \text{SnX}_2 < \text{PbX}_2$.
- (c) The order of boiling point of hydrides of group-14 element is $\text{CH}_4 < \text{SiH}_4 < \text{GeH}_4 < \text{SnH}_4$.
- (d) MeSiCl_3 on hydrolysis and subsequent condensation will produce $(\text{MeSi}(\text{OH}))_3$.

Numerical Value Type

24. Compounds X and Y are obtained by the reaction of Cl_2 with cold and dil. NaOH and compounds X and Z are formed with hot and conc. NaOH. The sum of oxidation state of chlorine in Y and Z is
25. How many of the following compounds liberate carbon dioxide gas from sodium carbonate? $\text{FeCl}_3, \text{MgCl}_2, \text{AlCl}_3, \text{CuSO}_4, \text{ZnSO}_4, (\text{CH}_3\text{COO})_2\text{Pb}, \text{CaCl}_2, \text{BaCl}_2$
26. When $(\text{CH}_3)_2\text{AlCl}$ is ignited CH_4 , Cl^- and Al^{3+} are produced as follows:
- $$(\text{CH}_3)_2\text{AlCl} \longrightarrow x\text{CH}_4 + y\text{Cl}^- + \text{Al}^{3+}$$
- The ignition of 0.643 g of $(\text{CH}_3)_2\text{AlCl}$ yields 1.39×10^{-2} moles of CH_4 . The resulting solution on reaction with excess AgNO_3 yields 6.64×10^{-3} moles of AgCl .
- The minimum molecular mass of $(\text{CH}_3)_2\text{AlCl}$ is

Comprehension Type

Solid compounds of carbon with elements other than hydrogen are generally called carbides. Carbides are of three types: (i) ionic or salt like carbides, (ii) interstitial carbides, formed by transition metals in which carbon atoms occupy tetrahedral holes in the closed packed arrays of metal atoms, these are generally very hard and very high melting solids, (iii) covalent carbides, these are formed by metalloids like Si, B, etc.

27. Identify (X) to (Z) in the following sequence of reactions.



- (a) $(\text{X}) = \text{Be}_2\text{C}$, $(\text{Y}) = \text{Be}(\text{OH})_2$, $(\text{Z}) = \text{C}_2\text{H}_4$
 (b) $(\text{X}) = \text{BeC}_2$, $(\text{Y}) = \text{Be}(\text{OH})_2$, $(\text{Z}) = \text{CH}_4$
 (c) $(\text{X}) = \text{Be}_2\text{C}$, $(\text{Y}) = \text{Be}(\text{OH})_2$, $(\text{Z}) = \text{CH}_4$
 (d) $(\text{X}) = \text{BeC}$, $(\text{Y}) = \text{Be}(\text{OH})_2$, $(\text{Z}) = \text{CH}_4$

28. Carborundum + NaOH + air $\xrightarrow{1600^\circ\text{C}}$ (X) gas. Thus (X) is
- (a) CO (b) CO_2
 (c) Gaseous C (d) SiCl_4

Matrix Match Type

29. Match the following:

	Column I (Chemical Prop.)	Column II (Metals)
(A)	Metal sulphate $\xrightarrow{\Delta}$ metal oxide + SO_2 + O_2	p. Ba
(B)	Metal cation + $\text{H}_2\text{SO}_4 \rightarrow$ white ppt.	q. Sr
(C)	Metal + NH_3 (liquid) \rightarrow blue solution	r. Na
(D)	MCl_2 + conc. $\text{H}_2\text{SO}_4 \rightarrow$ white ppt.	s. Mg

Codes:

A	B	C	D
(a) p,q,r,s	p,r	p,q	p,s
(b) p,q,s	p,r	p,s	p,q,r,s
(c) p,q,s	p,q	p,q,r,s	p,q
(d) p,r,s	p,s	p,q,r	s

30. Match the following:

	Column I	Column II
(A)	$\text{Bi}^{3+} \rightarrow (\text{BiO})^+$	p. Heat
(B)	$[\text{AlO}_2]^- \rightarrow \text{Al}(\text{OH})_3$	q. Hydrolysis
(C)	$\text{SiO}_4^{4-} \rightarrow \text{Si}_2\text{O}_7^{6-}$	r. Acidification
(D)	$(\text{B}_4\text{O}_7^{2-}) \rightarrow [\text{B}(\text{OH})_3]$	s. Dilution by water

Codes:

A	B	C	D
(a) p	r,s	p	q,r
(b) r,s	p	r	q,s
(c) q	p,s	s	p,r
(d) q,s	q	r	q,r

Keys are published in this issue. Search now! ◆◆

CHECK YOUR PERFORMANCE

No. of questions attempted	If your score is	
No. of questions correct	> 80%	Your preparation is going good, keep it up to get high score.
Marks scored in percentage	60-80%	Need more practice, try hard to score more next time.
		< 60%	Stress more on concepts and revise thoroughly.

FOCUS

**Class
XII**

NEET/JEE 2019

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UNIT - 7 : Organic Compounds Containing Nitrogen | Biomolecules

ORGANIC COMPOUNDS CONTAINING NITROGEN

AMINES

- These are alkyl or aryl derivatives of ammonia formed by the replacement of one or more hydrogen atoms by corresponding number of alkyl or aryl groups.

Classification

Amines are classified into two categories :

- Aliphatic amines where nitrogen atom is directly bonded to one or more alkyl groups. These may be primary, secondary or tertiary amines.



- Aromatic amines where nitrogen atom is directly bonded to one or more aryl groups. These are arylamines or aralkylamines.



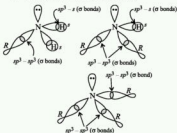
Nomenclature

- In common system, an aliphatic amine is named by prefixing alkyl group to amine, i.e., alkylamine. In IUPAC system, amines are named as alkanamines. In secondary and tertiary amines, when two or

more groups are the same, the prefix di or tri is appended before the name of alkyl group.

Structure

- The amines have a pyramidal shape and the nitrogen atom is sp^3 -hybridised. Out of the four hybrid orbitals, three singly filled orbitals form sigma bonds with the C-atom of alkyl group and the hydrogen atom, whereas the fourth hybrid orbital containing an electron pair is not involved in bond formation. Due to the presence of unshared pair of electrons the angle $\text{C}-\text{N}-\text{E}$ (where E is C or H) is less.



Orbital Structures of 1° , 2° and 3° Amines

Preparation

Reduction of nitro compounds:



Hofmann's ammonolysis method:



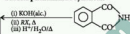
Mendius reduction:



Reduction of amides:



Gabriel phthalimide synthesis:



Hofmann bromamide degradation:



Basic Character

- The amines are basic in nature due to the presence of a lone pair of electron on N-atom of the -NH_2 group, which it can donate to electron deficient compounds. Aliphatic amines are stronger bases than NH_3 because of the +I effect of the alkyl groups. Greater the number of alkyl groups attached to N-atom, higher is the electron density on it and more will be the basicity. Thus, the order of basic nature of amines is expected to be $3^\circ > 2^\circ > 1^\circ$, however the observed order of basicity in aqueous solution is $2^\circ > 1^\circ > 3^\circ$. In aqueous solution, despite of inductive effect, solvation effect and steric hindrance also play an important role. The order of basicity varies with the nature of alkyl group.

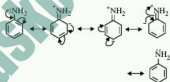
Alkyl group



Basic strength

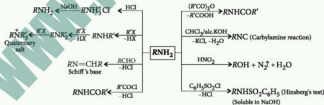


- Aniline is a weaker base compared to ammonia. This is because the lone pair of electrons on N-atom of aniline is less available for protonation due to its involvement in conjugation with the π -electrons of the benzene ring.



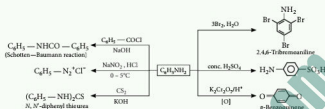
Further the presence of electron withdrawing groups like -NO_2 , -CN , -X , etc., decreases the basicity while, the presence of electron donating groups like -OCH_3 , -CH_3 , -NH_2 , etc., activates the benzene ring and also increases the basicity.

Chemical Properties of Aliphatic Amines



Chemical Properties of Aniline

- Aniline undergoes electrophilic substitution reactions. -NH_2 group is *ortho* and *para* directing and a powerful activating group.



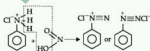
Identification of Primary, Secondary and Tertiary Amines

Test	Primary amine	Secondary amine	Tertiary amine
1. Reaction with nitrous acid.	Gives alcohol with effervescence of N_2 gas.	Gives yellow oily compound nitrosoamine.	Forms nitrite in cold which is soluble in water and on heating gives nitrosoamine.
2. Reaction with benzene sulphonyl chloride (Hinsberg's reagent).	Gives <i>N</i> -alkylbenzene-sulphenamide which is soluble in alkali.	Gives <i>N,N</i> -dialkylbenzene sulphonamide which is insoluble in alkali.	No reaction
3. Carbylamine test : Reaction with chloroform and alcoholic KOH.	Forms carbylamine or isocyanide (RNC) with characteristic unpleasant odour.	No reaction	No reaction
4. Hofmann's mustard oil reaction : Reaction with CS_2 and HgCl_2 .	Forms <i>N</i> -substituted isothiocyanate with characteristic unpleasant smell of mustard oil.	No reaction	No reaction

DIAZONIUM SALTS

- The diazonium salts have the general formula ArN_2^+X^- where X^- may be an anion like Cl^- , Br^- , etc. and the group N_2^+ is called diazonium ion group.

Preparation



COMIC CAPSULE

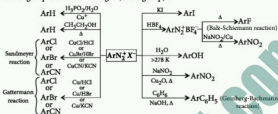
EVERYTHING SEEKS THE LOWEST POSSIBLE ENERGY.



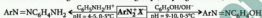
FOR PEOPLE, WE KNOW THIS BECAUSE TAKING A NAP FEELS SO GOOD.
FOR BONDS, WE KNOW THIS BECAUSE WE CAN CALCULATE A BONDING POTENTIAL.

Chemical Properties

- Reactions involving displacement of nitrogen (diazo group) :



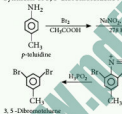
- Reactions involving retention of diazo group (coupling reactions) :



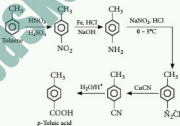
Importance in Synthetic Organic Chemistry

- Diazonium salts are highly useful intermediates in the synthesis of large variety of aromatic compounds. These are used for the preparation of many organic compounds especially aryl halides.

Synthesis of 3, 5-dibromotoluene :



Synthesis of p-toluic acid :



Similarly diazonium salts are used for the manufacture of azo dyes.

BIOMOLECULES

CARBOHYDRATES

- Carbohydrates are defined as polyhydroxy aldehydes or ketones or substances that generally give these on hydrolysis and contain at least one chiral carbon, hence are optically active. Their general formula is $\text{C}_x(\text{H}_2\text{O})_y$, where x and y can be 3, 4, 5, ..., etc.

Classification of Carbohydrates

- Based on molecular size :

On the basis of the molecular size, carbohydrates have been classified into three types :

- Monosaccharides
- Oligosaccharides
- Polysaccharides

• **Based on taste:**

- Carbohydrates with sweet taste are called *sugars* while those without a sweet taste are called *non-sugars*.
- All mono- and oligosaccharides are sugars while polysaccharides are non-sugars.

• **Based on reducing property:**

Reducing sugars

- Free aldehydic or ketonic group.
- Reduce Fehling's solution and Tollens' reagent
- e.g., maltose and lactose.

Non-reducing sugars

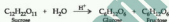
- Do not have free aldehydic or ketonic group.
- Do not reduce Fehling's solution and Tollens' reagent.
- e.g., Sucrose.

Glucose

- Glucose ($C_6H_{12}O_6$) is an aldohexose as it has six carbon atoms and an aldehyde group.

• **Preparation**

- Laboratory method:

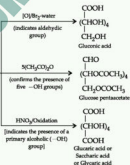


- Commercial method:



• **Structure**

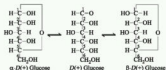
- Glucose was assigned open chain structure on the basis of following evidences:



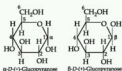
- The straight chain form of glucose explained most of its properties but could not explain a few reactions and observations like

- No reaction with 2,4-DNP and $NaHSO_3$.
- No reaction of its pentaacetate with NH_2OH .
- Existence of α and β -forms of glucose.

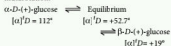
These could however be explained by the cyclic structure of glucose which exists in equilibrium with the open chain form.



- The cyclic structure of glucose is represented by Haworth structure:



- Mutarotation** : When these two anomeric forms are separately dissolved in water, they undergo a change in specific rotation till it becomes constant after some time. The change in specific rotation of isomers in aqueous solution is called mutarotation.

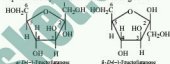


Fructose ($\text{C}_6\text{H}_{12}\text{O}_6$)

- It is present in abundance in fruits. Since naturally occurring fructose is laevorotatory, it is known as laevulose.



- The cyclic structures of two anomers of fructose are represented by Haworth structures as given :



Disaccharides and Polysaccharides

Carbohydrate	Hydrolysis products	Linkage	Reducing property
Sucrose (Disaccharide)	α -D-Glucose and β -D-Fructose	C-1 (Glucose) and C-2 (Fructose)	Non-reducing
Maltose (Disaccharide)	α -D-Glucose	C-1 (Glucose) and C-4 (Glucose)	Reducing
Lactose (Disaccharide)	β -D-Galactose and β -D-Glucose	C-1 (Galactose) and C-4 (Glucose)	Reducing
Starch (Polysaccharide)	Amylose and Amylopectin	Amylose (C-1 and C-4 glycosidic linkage between α -D-Glucose) Amylopectin (C-1 and C-4 linkage between α -D-Glucose and branching occurs by C-1 and C-6 linkage)	Non-reducing
Cellulose (Polysaccharide)	β -D-Glucose	C-1 (Glucose) and C-4 (Glucose)	Non-reducing
Glycogen (Polysaccharide)	α -D-Glucose	C-1 (Glucose) and C-4 (Glucose)	Non-reducing

PROTEINS

Proteins are complex polyamides formed from amino acids. They are essential for proper growth and maintenance of body. They have many peptide ($-\text{CONH}-$) linkages. Therefore, proteins are long

polymers of amino acids linked by peptide bonds (polypeptides).

Amino Acids

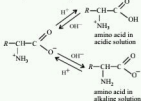
- Amino acids are colourless, non-volatile solids with high melting points, highly soluble in water yielding a neutral solution.

- Except glycine all amino acids have a chiral carbon and exist as optical isomers (*D* and *L* forms). All naturally occurring α -amino acids belong to the *L*-form.

- Chemical properties of α -amino acids :**

Since these form salt with acids as well as with bases, their chemical reactions are similar to primary amines and carboxylic acids.

- The equilibria are expressed as follows :



- **Isoelectric point :** The pH at which dipolar ion (zwitter ion) exists as neutral ion, i.e., +ve and -ve charge is equal and it does not migrate to either electrode, is called isoelectric point. Amino acids have least solubility at isoelectric point which helps in their separation.

Classification of Proteins

Fibrous proteins

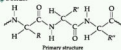
In fibrous proteins, polypeptide chains are parallel and are held together by hydrogen and disulphide bonds. These are insoluble in water, e.g., keratin and myosin.

Globular proteins

Globular proteins result when the polypeptide chains coil around to give three dimensional spherical shape. These are soluble in water, e.g., insulin and albumins.

Structure

- Primary structure :** It refers to the number and linear sequence of amino acids held together by peptide bonds.



- Secondary structure :** It is due to folding or coiling of the peptide chain. It is mainly of two types :

- **α -Helix :** These coils are stabilized by hydrogen bonds between carbonyl oxygen of first amino acid to amide nitrogen of fourth amino acid.
- **β -Pleated sheet structure :** β -pleated sheet structure is formed when hydrogen bonds are formed between the carbonyl oxygens and amide hydrogens of two or more adjacent polypeptide chains. The bonding in β -pleated sheet structure is intermolecular H-bonding. The structure is not planar but is slightly pleated. Silk fibroin is rich in β -pleated sheets.



- Tertiary structure :** It represents overall folding of the polypeptide chains, i.e., further folding of the secondary structure and the bonds responsible for such interaction are hydrophobic interactions, hydrogen bonds, ionic interactions, van der Waals' forces and disulphide bonds.

- Quaternary structure :** The spatial arrangement of the subunits (two or more polypeptide chains) with respect to each other.

Denaturation of proteins

- When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix gets uncoiled and protein loses its biological activity. This is called denaturation of protein.
- The denaturation causes change in secondary and tertiary structures but primary structure remains intact.

NUCLEIC ACIDS

Nucleic acids are polynucleotides present in the nuclei of all living cells in the form of nucleoproteins.

- There are three basic components of each nucleotide monomeric unit, viz, pentose sugar, nitrogenous base and phosphate group.

MAP

CONDENSATION REACTIONS



Aldol Condensation

Aldol is formed in the case of α -hydroxyketones. In absence of γ -hydroxy ketone, aldol condensation is not possible. Aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. Aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. Aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Aldol Condensation

The addition reaction of acid or alkali to the carbonyl group of aldehydes or ketones is known as aldol (aldol = alcohol + aldehyde). The β -hydroxyaldehyde and the β -hydroxyketone are obtained through aldol condensation. The first part of the reaction is an aldol reaction and the second part is an aldol condensation. Aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Claisen Condensation

The Claisen condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Ketone Aldol Condensation

Ketone aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Reverse Condensation

The condensation of aldehydes or ketones with α -hydroxy ketone to form a β -hydroxyketone is a reverse condensation reaction. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Mechanism
The mechanism involves the formation of an alkoxide ion. The alkoxide ion then attacks the carbonyl group in a nucleophilic addition reaction. The next step is an aldol condensation reaction. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.



Aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Single Aldol Condensation

Single aldol condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

The aldol condensation reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.

Comparison with Aldol Condensation

Comparison with Aldol Condensation is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone. The reaction is a reaction between two molecules of α -hydroxyketone to form a β -hydroxyketone.



Applications of Condensation Reactions

- Condensation reactions are widely used for organic synthesis.
- Condensation reactions are also very important in biological synthesis like glycolysis, phosphorylation, polypeptide and polysaccharide synthesis.
- Condensation reactions are also very important in polymer industry for example in preparation of nylon, dacron, etc.

Classification of Nucleic Acid

Components	Deoxyribonucleic Acid (DNA)	Ribonucleic Acid (RNA)
Sugar	2-deoxy-D-(-) ribose	D-(-)ribose
Pyrimidine base	Cytosine and thymine	Uracil and cytosine
Purine base	Adenine and guanine	Adenine and guanine
Phosphoric acid	H ₃ PO ₄	H ₃ PO ₄
Structure	Double stranded α -helix	Single stranded α -helix
Replication	Possible	Not possible

Chargaff's Rule

- The rule describes base composition of a DNA molecule.
 - It states that amount of purine bases is always equal to that of pyrimidine bases.
 - Purine base of one strand of DNA molecule pairs with pyrimidine base of the other strand.
 - Adenine (A) pairs with thymine (T) through two H-bonds (A = T) and guanine (G) pairs

with cytosine (C) through three H-bonds (G \equiv C).

- In case of RNA, adenine (A) pairs with uracil (U), (A = U).

Biological Functions of Nucleic Acids

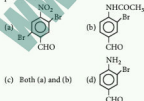
- Replication** : It is the enzyme catalysed process by which a single DNA molecule produces two identical copies of itself.
- Protein synthesis** : It is carried out by RNA molecules in two steps :
 - Transcription** : It is the process of synthesis of RNA from DNA in the cytoplasm of the cell.
 - Translation** : The m-RNA directs the protein synthesis by this process.
- Genetic code** : Linear sequences of three nucleotides (triplets) in DNA or RNA that determines the specific amino acid sequence in the synthesis of proteins is called genetic code. It is the biochemical basis of heredity and nearly universal in all organisms.
- Mutation** : It is a change in nitrogenous base sequence of DNA molecule which leads to the synthesis of proteins with an altered sequence of amino acids. Mutation may cause genetic disorders or diseases.

SPEED PRACTICE

1. In the given reaction,



product C is

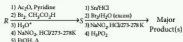


2. Which of the nitrogen of histidine is first protonated?



- (a) α -N (b) β -N
(c) Both α -N and β -N (d) None of these

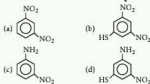
3. Aniline reacts with mixed acid (conc. HNO₃ and conc. H₂SO₄) at 288 K to give P (51 %), Q (47 %) and R (2%). The major product(s) of the following reaction sequence is (are)





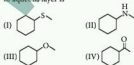
(JEE Advanced 2018)

4. The major product (70% to 80%) of the reaction between *m*-dinitrobenzene with NH_4HS is



5. When $\text{H}_2\text{N}-\text{CH}(\text{R})-\text{COOH}$ is acylated using Ac_2O

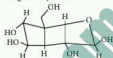
- (a) its configuration is retained
 (b) its configuration is inverted
 (c) it becomes unstable
 (d) no reaction takes place.
6. In carbylamine reaction,
 (a) the nucleophile is RNH_2 and electrophile is CCl_2
 (b) the nucleophile is primary amine and electrophile is CCl_3^+
 (c) the nucleophile is CCl_3^- and the electrophile is primary amine
 (d) the attacking reagent is electrophile.
7. A mixture containing the following four compounds is extracted with 1 M HCl. The compound that goes to aqueous layer is



- (a) (II) (b) (IV)
 (c) (I) (d) (III)

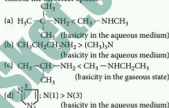
(JEE Main 2017)

8. The following carbohydrate is

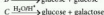


- (a) a ketohexose (b) an aldohexose
 (c) an α -furanose (d) an α -pyranose.

9. Choose the incorrect option.



10. Consider the following hydrolysis reactions,



the disaccharides A, B and C respectively are

- (a) lactose, sucrose, maltose
 (b) sucrose, maltose, lactose
 (c) sucrose, lactose, maltose
 (d) maltose, sucrose, lactose.
11. Consider the following statements about carbohydrates:
- I. Bromine water can be used to differentiate an aldose from a ketose.
 - II. All monosaccharides, whether aldose or ketose, are reducing sugars.
 - III. During Osazone formation, only C_1 and C_2 are involved.
 - IV. A pair of diastereomeric aldoses which differ only in configuration about C-2 is termed as pair of anomers.
- Which of the above statements are correct?

- (a) I and IV only (b) II and IV only
(c) I, II and III only (d) II, III and IV only

12. The correct statement regarding the basicity of arylamines is

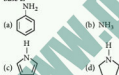
- (a) arylamines are generally more basic than alkylamines because of aryl group
(b) arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is sp -hybridised
(c) arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalised by interaction with the aromatic ring π -electron system
(d) arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalised by interaction with the aromatic ring π -electron system.

(NEET Phase-I 2016)

13. An organic compound 'A' has molecular formula, C_7H_9N and it forms a clear solution when dissolved in aqueous KOH solution of benzene sulphonyl chloride. 'A' on treatment with $NaNO_2$ and HCl at $0^\circ C$ and then with 2-naphthol forms an intensely coloured compound. Also 'A' on treatment with CH_3COCl followed by electrophilic substitution yields a single product. Identify A.

- (a) 4-Methylaniline (b) 2-Methylaniline
(c) 3-Methylaniline (d) *N*-Methylaniline

14. Among the following amines, the strongest Brønsted base is

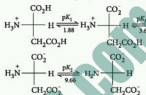


15. The most important contribution to the stability of a protein conformation appears to be the

- (a) entropy increase from the decrease in ordered water molecules forming a solvent shell around it
(b) maximum entropy increase from ionic interactions between the ionized amino acids in a protein
(c) sum of free energies of formation of many weak interactions between its polar amino acids and surrounding water molecules

(d) sum of free energies of formation of many weak interactions among the hundreds of amino acids in a protein.

16. Consider the following sequence for aspartic acid:



The pI (isoelectric point) of aspartic acid is

- (a) 3.65 (b) 2.77
(c) 5.74 (d) 1.88

(JEE Main 2016)



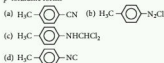
In the above sequence, II is

- (a) β -alanine (b) α -alanine
(c) ethylenediamine (d) γ -aminobutyric acid.

18. Among the following the achiral amino acid is

- (a) ethylalanine (b) methylglycine
(c) 2-hydroxymethylserine
(d) tryptophan.

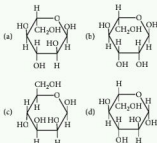
19. The reaction of chloroform with alcoholic KOH and p -toluidine forms



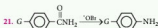
20. The Fischer presentation of D -glucose is given below.



The correct structure(s) of β - D -glucopyranose is (are)



(JEE Advanced 2018)



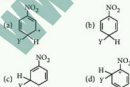
The rate of Hofmann degradation is influenced by the nature of substituent G. Which of the following represent the correct decreasing rate of degradation with various substituents?

- (a) $-\text{NO}_2 > -\text{Cl} > -\text{H} > -\text{CH}_3 > -\text{OCH}_3$
 (b) $-\text{OCH}_3 > -\text{CH}_3 > -\text{Cl} > -\text{H} > -\text{NO}_2$
 (c) $-\text{OCH}_3 > -\text{CH}_3 > -\text{H} > -\text{Cl} > -\text{NO}_2$
 (d) $-\text{CH}_3 > -\text{Cl} > -\text{H} > -\text{OCH}_3 > -\text{NO}_2$

22. Which of the following hexoses will form the same osazone when treated with excess of phenylhydrazine?

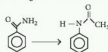
- (a) D-glucose, D-fructose and D-galactose
 (b) D-glucose, D-fructose and D-mannose
 (c) D-glucose, D-mannose and D-galactose
 (d) D-fructose, D-mannose and D-galactose

23. Which of the following carbocations is expected to be most stable?



(NEET 2018)

24. The reagents needed to convert



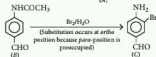
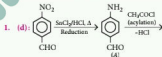
are

- (a) KOH, Br₂; LiAlH₄
 (b) KOH, Br₂; CH₃COCl
 (c) HONO, Cu₂Cl₂; (CH₃CO)₂O
 (d) KOH, Br₂; Ni, H₂; CH₃COCl
25. What sequence of reactions would best accomplish the following reaction?

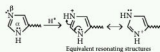


- (a) (i) LiAlH₄ in ether; (ii) P₂O₅ and heat
 (b) (i) LiAlH₄ in ether; (ii) 3CH₃I followed by heating with AgOH
 (c) (i) 20% H₂SO₄ and heat; (ii) P₂O₅ and heat
 (d) H₂ and Lindlar's catalyst

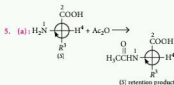
SOLUTIONS



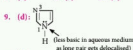
2. (b): Protonation of β-N leads to imidazolium ion, which is stabilised by two equivalent resonating structures.



3. (d)
 4. (c)



6. (a) 7. (a) 8. (b)



10. (b)

11. (c): A pair of diastereomeric aldoses which differ only in configuration about C-2 is termed as pair of epimers.

12. (c): In arylamines, lone pair of electrons on nitrogen atom is delocalised over the benzene ring, thus, not available for donation. So, arylamines are less basic than alkylamines ($\text{R}-\text{NH}_2$).

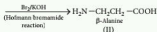
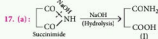
13. (a): Formation of single product in electrophilic substitution reaction indicates the symmetrical structure, (i.e., *p*-substitution) of A. Formation of dye stuff with NaNO_2/HCl (0°C) and 2-naphthol suggests that it is an aromatic primary amine. Thus, possible structure of A is



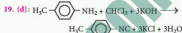
14. (d): In (a) and (c), lone pair of electrons involves in resonance so less available for protonation. In (d), lone pair is more available than NH_2 for protonation. So, (d) is the strongest Brønsted base.

15. (a)

16. (b): $\text{pI} = \frac{\text{p}K_1 + \text{p}K_2}{2} = \frac{1.88 + 3.65}{2} = \frac{5.53}{2} = 2.765 \approx 2.77$



18. (c): It does not contain a chiral centre.



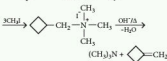
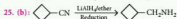
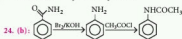
20. (d): Structure of β -D-glucopyranose is



21. (c)

22. (b): D-glucose, D-fructose and D-mannose give the same osazone because they differ in configuration only at C_1 and C_2 but have the same configuration at C_3 , C_4 and C_5 .

23. (c): $-\text{NO}_2$ group is *meta*-directing thus, it will stabilise an electrophile at *m*-position.







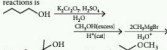




MONTHLY TUNE UP CLASS XI ANSWER KEY

1. (a)	2. (a)	3. (a)	4. (b)	5. (a)
6. (a)	7. (d)	8. (b)	9. (a)	10. (c)
11. (a)	12. (b)	13. (a)	14. (a)	15. (c)
16. (c)	17. (a)	18. (d)	19. (b)	20. (a,b)
21. (b,c,d)	22. (a,b,c,d)	23. (a,b,c)	24. (6)	25. (6)
26. (92.5)	27. (c)	28. (b)	29. (c)	30. (d)

Class XII

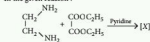
Be **NEET****READY**with exclusive and brain
storming MCQs

Practicing these MCQs helps to strengthen your concepts and give you extra edge in your NEET preparation

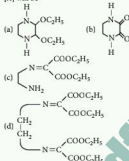
- When a liquid that is immiscible with water was steam distilled at 95.2°C at a total pressure of 748 torr, the distillate contained 1.25 g of the liquid per gram of water. The vapour pressure of water is 648 torr at 95.2°C , what is the molar mass of liquid?
(a) 7.975 g/mol (b) 166 g/mol
(c) 145.8 g/mol (d) None of these
- When NaCl or KCl is heated with conc. H_2SO_4 and solid $\text{K}_2\text{Cr}_2\text{O}_7$, we get
(a) chromic chloride (b) chromous chloride
(c) chromyl chloride (d) chromic sulphate.
- Which compound undergoes hydrolysis by the $\text{S}_{\text{N}}1$ mechanism at the fastest rate?
(a)  (b) 
(c)  (d) 
- In the silver plating of copper, $\text{K}[\text{Ag}(\text{CN})_2]$ is used instead of AgNO_3 . The reason is
(a) a thin layer of Ag is formed on Cu
(b) more voltage is required
(c) Ag^+ ions are completely removed from solution
(d) limited availability of Ag^+ ions, as $[\text{Ag}(\text{CN})_2]^-$ ion is very stable.
- A crystal is made of particles X, Y and Z. X forms fcc packing, Y occupies all octahedral voids of X and Z occupies all tetrahedral voids of X, if all the particles along one body diagonal are removed then the formula of the crystal would be
(a) XYZ_2 (b) X_2YZ_2 (c) $\text{X}_8\text{Y}_4\text{Z}_5$ (d) $\text{X}_5\text{Y}_4\text{Z}_4$
- The end product of the following sequence of reactions is

(a)  (b) 
(c)  (d) 
- When the electric current is passed through a cell having an electrolyte, the positive ions move towards cathode and negative ions towards the anode. If the cathode is pulled out of the solution then
(a) the positive and negative ions will move towards anode
(b) the positive ions will start moving towards the anode while negative ions will stop moving
(c) the negative ions will continue to move towards anode while positive ions will stop moving
(d) the positive and negative ions will start moving randomly.

8. An oxide has the following properties:
 (i) acts both as a proton donor as well as proton acceptor
 (ii) it reacts readily with basic and acidic oxides
 (iii) it oxidises Fe at its boiling point.
 The oxide is
 (a) P_2O_5 (b) SiO_2 (c) H_2O (d) CO_2

9. In the given reaction:



[X] will be

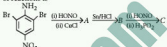





10. For the reaction, $2\text{NO}_2 \rightarrow \text{N}_2\text{O}_4 + \text{O}_2$, rate expression is as follows $-\frac{d[\text{NO}_2]}{dt} = k[\text{NO}_2]^n$, where, $k = 3 \times 10^{-5} \text{ mol}^{-1} \text{ L s}^{-1}$. If the rate of formation of oxygen is $1.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$, then the molar concentration of NO_2 in mol L^{-1} is
 (a) 1.5×10^{-4} (b) 0.0151
 (c) 0.214 (d) 0.316

11. Consider the following statements:

- (A) In the aluminothermite process, aluminium acts as reducing agent.
 (B) The process of extraction of gold involves the formation of $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{CN})_4]^{2-}$.
 (C) In the extractive metallurgy of zinc, partial fusion of ZnO with coke is called sintering and reduction of ore to the molten metal is called smelting.
 (D) Extractive metallurgy of silver from its argentite involves complex formation and displacement by more electropositive metal.

Which of the following statements are true?

- (a) A and B only (b) B and C only
 (c) A, B and C only (d) A, B, C and D
12. The product (C) obtained in the following sequence of reactions is
- 
- (a)  (b) 
 (c)  (d) None of these

13. Applying Freundlich adsorption isotherm, calculate the amount of acetic acid adsorbed by 1 kg of blood charcoal at 25°C from a 5% vinegar solution (mass/volume). (Given that if the concentration is expressed in molarity (mol dm^{-3}), x/m is mass of the solute adsorbed per gram of adsorbent, then $k = 0.160$ and $n = 2.32$.)
 (a) 147.8 (b) 150.2 (c) 158.1 (d) 140.2
14. Hydrolysis of adenosine triphosphate involves rupture of
 (a) base-sugar bond
 (b) sugar-phosphate bond
 (c) $\text{P}-\text{O}-\text{P}$ bond (d) $\text{P}-\text{N}-\text{P}$ bond.
15. The monomer that can undergo radical, cationic and anionic polymerisation with equal ease is
 (a) $\text{Me}-\text{C}(\text{Me})=\text{CH}_2$ (b) $\text{Ph}-\text{CH}=\text{CH}_2$
 (c) $\text{CH}_2=\text{CH}_2$ (d) $\text{CH}_2=\text{CH}-\text{CN}$

SOLUTIONS

1. (c) : For two immiscible liquids,

$$\frac{P_A}{P_B} = \frac{P_{\text{total}}}{P_{\text{H}_2\text{O}}} = \frac{748}{648} \Rightarrow 100$$

$$\frac{W_A}{W_B} = \frac{P_A M_A}{P_B M_B}; M_A = \frac{1.25}{1} \times \frac{648 \times 18}{100} \Rightarrow 145.8$$
2. (c) : $4\text{NaCl} + \text{K}_2\text{Cr}_2\text{O}_7 + 6\text{H}_2\text{SO}_4 \rightarrow 4\text{NaHSO}_4 + 2\text{KHSO}_4 + 2\text{CrO}_2\text{Cl}_2 + 3\text{H}_2\text{O}$
 Chromium chloride
3. (c) : Reaction intermediate carbocation of compound (C) is more stable than carbocations of other molecules.

4. (d) : In silver plating, $K[Ag(CN)_2]$ is used which provides constant and required supply of Ag^+ ions as $[Ag(CN)_2]^-$ is very stable. But if $AgNO_3$ is used concentration of $[Ag^+]$ in solution will be very large as it is an ionic molecule. In that case Ag will be deposited at faster rate without any uniformity.

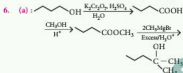
5. (d) : When all the particles along one body diagonal are removed, that means two X particles from the corner are removed, one Y particle is removed and two Z particles are removed.

Hence, the new arrangement,

$$X \text{ particle} = \frac{1}{8} \times 6 + \frac{1}{2} \times 6 = \frac{15}{4}; Y \text{ particles} = 3;$$

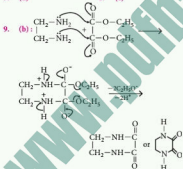
$$Z \text{ particles} = 6$$

$$\text{Hence, formula} = X_{15/4}Y_3Z_6 = X_{5/4}YZ_2 = X_5Y_4Z_8$$



7. (d)

8. (c)



10. (d) : From the unit of k , it is evident that it is a second order reaction.

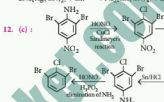
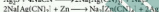
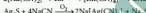
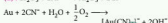
$$-\frac{1}{2} \frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt}$$

$$\therefore -\frac{d[NO_2]}{dt} = 2 \times \frac{d[O_2]}{dt} = 2 \times 1.5 \times 10^{-4} = 3 \times 10^{-4}$$

$$3 \times 10^{-4} = k[NO_2]^2 = 3 \times 10^{-3} [NO_2]^2$$

$$\therefore [NO_2] = 0.316 \text{ mol L}^{-1}$$

11. (d) : $Cr_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Cr$



13. (a) : According to Freundlich adsorption isotherm, $\frac{x}{m} = kC^{1/n}$... (i)

5% vinegar (acetic acid solution) means 5 g of acetic acid are present in 100 mL of the solution.

Molar mass of acetic acid (CH_3COOH) = 60 g mol⁻¹

$$\therefore 5 \text{ g of acetic acid} = \frac{5}{60} \text{ mol}$$

\therefore 1000 mL of the solution will contain acetic acid

$$= \frac{5}{60} \times \frac{1}{100} \times 1000 = 0.833 \text{ mol L}^{-1}$$

i.e., Concentration of the solution (C) = 0.833 mol L⁻¹

$$\frac{x}{m} = 0.160 \times (0.833)^{1/2.32}$$

$$\therefore \log \frac{x}{m} = \log(0.160) + \frac{1}{2.32} \log(0.833)$$

$$= -0.7959 + 0.431 (-0.0794) = -0.8301$$

$$\therefore \frac{x}{m} = \text{Antilog}(-0.8301) = 0.1478 \text{ g}$$

\therefore Amount adsorbed by 1 kg (1000 g) of charcoal = 147.8 g

14. (c)

15. (b)

Quotable Quote

The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom.

Isaac Asimov

CLASS XII

CBSE DRILL



Practice Paper 2019

Practice paper for CBSE Exams as per the latest pattern and marking scheme issued by CBSE for the academic session 2018-19.

GENERAL INSTRUCTIONS

- All questions are compulsory.
- Section A: Ques. 1 to 5 are very short answer questions and carry 1 mark each.
- Section B: Ques. 6 to 12 are short answer questions and carry 2 marks each.
- Section C: Ques. 13 to 24 are also short answer questions and carry 3 marks each.
- Section D: Ques. 25 to 27 are long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of one mark, two questions of two marks, four questions of three marks and all the three questions of five marks each. You have to attempt only one of the choices in such questions.
- Use log tables if necessary, use of calculators is not allowed.

Time Allowed : 3 hours

Maximum Marks : 70

SECTION-A

- What happens when ferrimagnetic substance Fe_3O_4 is heated at 850 K and why?
- What type of forces are responsible for the occurrence of physisorption?

OR

Based on the type of dispersed phase, what type of colloids are micelles?

- Arrange the following polymers in order of increasing intermolecular forces:
Bakelite, Nylon 6,6, Polythene, Neoprene.
- Why are low spin tetrahedral complexes not formed?

OR

Name the ionisation isomer of $[\text{Cr}(\text{H}_2\text{O})_5\text{Br}]\text{SO}_4$.

- Out of *ortho* and *para* isomers of aryl halides which one has higher melting point?

SECTION-B

- Boiling point of water at 750 mm Hg is 99.63°C . How much sucrose is to be added to 500 g of water such that it boils at 100°C ? Molar elevation constant for water is $0.52 \text{ K kg mol}^{-1}$.

OR

How many g of glucose must be present in 0.5 litre of a solution for its osmotic pressure to be same as that of solution of 9.2 g glucose per litre?

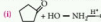
- Complete each synthesis by giving the missing material, reagent or product:



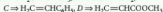


OR

Predict the products of the following reactions :



8. Arrange the following alkenes $A \rightarrow D$, towards order of increasing reactivity in cationic polymerisation :



9. Account for the following :

(i) Preparation of ethers by acid dehydration of secondary or tertiary alcohols is not a suitable method.

(ii) The boiling points of ethers are lower than isomeric alcohols.

10. The reaction $\text{SO}_2\text{Cl}_2 \rightarrow \text{SO}_2 + \text{Cl}_2$ is a first order reaction with $k = 2.2 \times 10^{-5} \text{ s}^{-1}$ at 320°C . Calculate the percentage of SO_2Cl_2 that is decomposed on heating for 30 minutes.

11. Which halogen will produce O_2 and O_3 as passed through water?

12. Explain why $\text{Hg}(\text{I})$ ion exists as Hg_2^{2+} while $\text{Cu}(\text{I})$ ion exists as Cu^+ ion.

SECTION C

13. Calculate the per cent change in density when *bcc* iron changes to *fcc* iron, on heating. The lengths of the edges in the *bcc* and *fcc* lattices are 286.3 pm and 359.1 pm respectively.

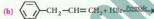
14. Two elements A and B form compounds having molecular formula AB_2 and AB_4 . When dissolved in 20 g C_6H_6 , 1 g of AB_2 lowers the f.p. by 2.3°C whereas 1.0 g of AB_4 lowers it by 1.3°C . The K_f for C_6H_6 is $5.1 \text{ K mol}^{-1} \text{ kg}$. Calculate atomic weight of A and B.

15. (i) 3,3-Dimethylbutan-2-ol loses a molecule of water in the presence of concentrated sulphuric acid to give tetramethylethylene as the major product. Suggest a suitable mechanism.

(ii) Why do phenols not give protonation reactions readily in comparison to alcohols?

16. (i) The treatment of an alkyl chloride with aqueous KOH leads to the formation of an alcohol whereas in the presence of alcoholic KOH, alkene is the major product. Give reason.

(ii) Draw the structure of major monohalo product in each of the following reactions :



OR

(a) Why is sulphuric acid not used during the reaction of alcohols with KI in the conversion of an alcohol to the alkyl iodide?

(b) Why are haloarenes less reactive than haloalkanes towards nucleophilic substitution reactions?

17. An organic compound with the molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms a 2, 4-DNP derivative, reduces Tollens reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid. Identify the compound.

18. Account for the following :

(i) Aspirin drug helps in the prevention of heart attack.

(ii) Diabetic patients are advised to take artificial sweeteners instead of natural sweeteners.

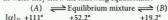
(iii) Detergents are non-biodegradable while soaps are biodegradable.

19. (i) Mention the biological importance of insulin.

(ii) Write the important structural and functional differences between DNA and RNA.

OR

An optically active compound having molecular formula, $\text{C}_6\text{H}_{12}\text{O}_6$ is found in two isomeric forms (A) and (B) in nature. When (A) and (B) are dissolved in water they show the following equilibrium :



(a) What are such isomers called?

(b) Can they be called enantiomers? Justify your answer.

(c) What is invert sugar?

20. A 1st order reaction is 50% complete in 30 minute at 27°C and in 10 minute at 47°C . Calculate the :

(a) rate constant for reaction at 27°C and 47°C

(b) energy of activation for the reaction

(c) energy of activation for the reverse reaction if heat of reaction is -50 kJ mol^{-1} .

OR

The decomposition of a compound is found to follow a first order rate law. If it takes 15 minutes for 20 per cent of original material to react, calculate

- the specific rate constant
 - the time at which 10 percent of the original material remains unreacted
 - the time it takes for the next 20 per cent of the reactant left after the first 15 minutes.
- (i) What is Helmholtz electrical double layer?
 - (ii) How is dialysis carried out? Mention its one application.
 - (iii) Physical adsorption is multilayered while chemical adsorption is monolayered. Why?
 - (ii) Why is the froth floatation method selected for the concentration of sulphide ores?
 - (iii) The values of $\Delta_f G^\circ$ for formation of Cr_2O_3 is -540 kJ mol^{-1} and that of Al_2O_3 is -827 kJ mol^{-1} . Is the reduction of Cr_2O_3 possible with Al?

OR

Describe the role of the following :

- Depressant in froth floatation process.
 - Silica in the extraction of copper from copper pyrites ore.
 - Cryolite in the metallurgy of aluminium.
- Describe the preparation of potassium dichromate from chromite ore. What is the effect of change of pH on dichromate ion?
 - (i) Out of NH_3 and CO , which ligand forms a more stable complex with a transition metal and why?
 - (ii) What do you understand by stepwise stability constant and overall stability constant of a coordination compound? How are these two constants related?

SECTION-D

- Account for the following :

- The $\text{p}K_a$ of aniline is more than that of methylamine.
- Methylamine reacts in water with ferric chloride to precipitate hydrated ferric oxide.
- Gabriel phthalimide synthesis is the preferred method for synthesizing primary amines.

OR

Answer the following :

- How is aniline obtained from benzene?
 - Why are the secondary amines more basic than primary amines? Explain.
 - Write the complete chemical reaction for the conversion of aniline to sulphanilic acid.
 - Mention two important uses of sulphanilic acid.
 - Write a chemical reaction of aniline which distinguish it from ethylamine.
- (a) Sodium salt of an acid A is formed on boiling white phosphorus with NaOH solution. (b) A on treatment with a solution of HgCl_2 first gives a white precipitate of compound B and then grey precipitate of C. Identify A to C and write balanced chemical equation for the reactions.
 - Draw the structure of A and predict the oxidation state of central atom in it.
 - Predict the species oxidising and reducing in step (i) (a). What name is given to such type of reactions?

OR

(a) Present a comparative account of the following :

- Proton affinities of NH_3 and PH_3 .
 - Physical states of nitrogen and phosphorus.
 - Shapes of ClO_2 and Cl_2O .
 - What happens when dilute nitric acid reacts with (i) Copper (ii) Zinc?
- Two half-reactions of an electrochemical cell are given below :
 $\text{MnO}_4^{2-}(\text{aq}) + 8\text{H}^+(\text{aq}) + 5e^- \rightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$
 $E^\circ = +1.51 \text{ V}$
 $\text{Sn}^{2+}(\text{aq}) \rightarrow \text{Sn}^{4+}(\text{aq}) + 2e^-$, $E^\circ = +0.15 \text{ V}$
 Construct the redox equation from the standard potential of the cell and predict if the reaction is reactant favoured or product favoured.
 - Calculate the strength of the current required to deposit 1.2 g of magnesium from molten MgCl_2 in 1 hour.

[1 F = $96,500 \text{ C mol}^{-1}$; Atomic mass : $\text{Mg} = 24.0 \text{ u}$]

OR

- A cell is prepared by dipping copper rod in 1 M copper sulphate solution and zinc rod in 1 M zinc sulphate solution. The standard reduction potential of copper and zinc are 0.34 V and -0.76 V respectively.

- (i) What will be the cell reaction?
 (ii) What will be the standard electromotive force of the cell?
 (iii) Which electrode will be positive?
 (b) Predict the products of electrolysis in each of the following:
 (i) An aqueous solution of AgNO_3 with platinum electrodes.
 (ii) An aqueous solution of H_2SO_4 with platinum electrodes.

SOLUTIONS

1. When ferrimagnetic Fe_3O_4 is heated at 850 K, it loses ferrimagnetism and becomes paramagnetic due to randomization of spins.
 2. The forces operating in these cases are weak van der Waals' forces.

OR

Associated colloids.

3. Neoprene < Polythene < Nylon 6,6 < Bakelite
 4. Low spin tetrahedral complexes are not formed because for tetrahedral complexes the CFSE is lower than pairing energy hence, pairing of electrons does not take place.

OR

The ionisation isomer of $[\text{Cr}(\text{H}_2\text{O})_5\text{Br}]\text{SO}_4$ is $[\text{Cr}(\text{H}_2\text{O})_5\text{SO}_4]\text{Br}$.

The IUPAC name of $[\text{Cr}(\text{H}_2\text{O})_5\text{SO}_4]\text{Br}$ is pentaquasulphatochromium(III) bromide.

5. *p*-Isomer has higher melting point due to symmetry.
 6. Elevation in boiling point $(\Delta T_b) = 100 - 99.63 = 0.37^\circ\text{C}$
 Mass of solvent (water), $w_1 = 500$ g
 Mass of solute $w_2 = ?$
 Molar mass of solvent, $M_1 = 18$ g mol^{-1}
 Molar mass of solute, $\text{C}_{12}\text{H}_{22}\text{O}_{11} = 342$ g mol^{-1}

Applying the formula, $\Delta T_b = K_b \times \frac{w_2 \times 1000}{M_2 \times w_1}$

$$\text{or, } w_2 = \frac{M_2 \times w_1 \times \Delta T_b}{1000 \times K_b} = \frac{342 \times 500 \times 0.37}{1000 \times 0.52} = 122 \text{ g}$$

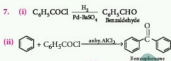
OR

For isotonic solutions of non-electrolytes;

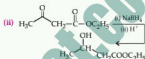
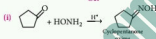
$$C_1 = C_2$$

$$\text{or } \frac{w_1}{m_1 V_1} = \frac{w_2}{m_2 V_2} \quad \text{or } \frac{w_1}{180 \times 0.5} = \frac{9.2}{180 \times 1}$$

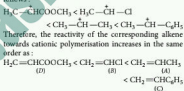
$$w_1 = 4.60 \text{ g}$$



OR



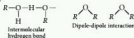
8. Reactivity of an alkene towards cationic polymerisation increases as the stability of the intermediate carbocation formed increases. The increasing order of the stability of the carbocation is as follows:



9. (i) Acid dehydration of 2° and 3° alcohols give alkenes rather than ethers. Due to steric hindrance the nucleophilic attack by the alcohol molecule on the protonated alcohol molecule does not occur.

The protonated 2° and 3° alcohols lose water molecules to form stable 2° and 3° carbocations.

- (ii) The boiling points of ethers are much lower than those of alcohol of comparable molar masses because like alcohols they cannot form intermolecular hydrogen bonds.



10. $k = \frac{2.303}{t} \log \frac{a}{a-x}$

$$\Rightarrow 2.2 \times 10^{-5} = \frac{2.303}{30 \times 60} \log \frac{a}{a-x}$$

$$\frac{a}{(a-x)} = \text{antilog } 0.01719 = 1.0404$$

$$0.0404a = 1.0404x \Rightarrow \frac{x}{a} = \frac{0.0404}{1.0404} = 0.0388 = 3.88\%$$

11. F_2 is highly reactive and has greater affinity for hydrogen. Therefore, it decomposes water at low temperature and even in dark liberating oxygen and ozone.



12. The electronic configuration of Hg^{2+} is $[Xe] 4f^{14} 5d^{10} 6s^1$. If this were so, the mercurous, $Hg(I)$ compounds should be paramagnetic but actually, they are diamagnetic. This behaviour can be explained by assuming that singly filled 6s-orbitals of the two Hg^{2+} ions overlap to form $Hg-Hg$ covalent bond. Thus, Hg_2^{2+} exists as dimeric species, i.e., Hg_2^{2+} .

On the other hand, the electronic configuration of Cu^+ ion is $[Ar] 3d^{10}$. It is stable configuration hence, it exists as Cu^+ ion.

13. Density of bcc iron,

$$d_{bcc} = \frac{2 \times M}{N_A \times (286.3 \times 10^{-10})^3} \text{ g/cm}^3 \quad (Z = 2 \text{ in bcc lattice})$$

Density of fcc iron,

$$d_{fcc} = \frac{4 \times M}{N_A \times (359.1 \times 10^{-10})^3} \text{ g/cm}^3 \quad (Z = 4 \text{ in fcc lattice})$$

$$\therefore \frac{d_{fcc}}{d_{bcc}} = \frac{\frac{4 \times M}{N_A \times (359.1 \times 10^{-10})^3}}{\frac{2 \times M}{N_A \times (286.3 \times 10^{-10})^3}} = \frac{4 \times (286.3 \times 10^{-10})^3}{2 \times (359.1 \times 10^{-10})^3} = 1.014$$

$$\therefore \text{Per cent change in density} = \frac{d_{fcc} - d_{bcc}}{d_{bcc}} \times 100$$

$$= (1.014 - 1) \times 100 = +1.4$$

Density increases by 1.4%.

$$14. \Delta T_f = \frac{1000 K_f w}{m W}$$

$$\text{For } AB_2 \quad 2.3 = \frac{1000 \times K_f \times 1}{m_1 \times 20} = \frac{1000 \times 5.1 \times 1}{m_1 \times 20}$$

$$\text{For } AB_4 \quad 1.3 = \frac{1000 \times K_f \times 1}{m_2 \times 20} = \frac{1000 \times 5.1 \times 1}{m_2 \times 20}$$

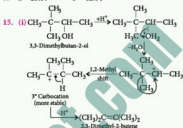
$$\Rightarrow m_1 = 110.87; \text{ and } m_2 = 196.15$$

$$\text{Now, } m_1 \text{ is m.wt. of } AB_2 \quad \therefore a + 2b = 110.87$$

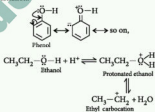
$$m_2 \text{ is m.wt. of } AB_4 \quad \therefore a + 4b = 196.15$$

where, a and b are at. wt. of A and B

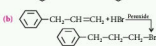
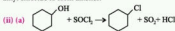
$$\therefore a = 25.59 \quad b = 42.64$$



(ii) In phenols, the lone pairs of electrons on the oxygen atom are delocalised over the benzene ring due to resonance and hence are not easily available for protonation whereas, in case of alcohols, the lone pairs of electrons on the oxygen atom are localised due to absence of resonance and hence are easily available for protonation.

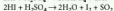
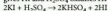


16. (i) In aqueous solution, KOH is almost completely ionised to give OH^- ion which being a better nucleophile gives a substitution reaction on alkyl halides to form alcohol. But an alcoholic solution of KOH containing alkoxide (RO^-) ions which being a much stronger base than OH^- ion preferentially snatches a H^+ ion from an alkyl chloride to form alkenes.



OR

(a) H_2SO_4 is an oxidant. KI reacts with H_2SO_4 and gives HI and H_2SO_4 oxidises HI to I_2 .

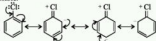


Thus, HI will not be available for reaction with alcohol to form alkyl iodide.

This is why sulphuric acid is not used during the reaction of alcohols with KI.

(b) Haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions due to the following reasons:

(i) **Resonance effect**: In haloarenes the electron pairs on halogen atom are in conjugation with π -electrons of the ring and the following resonating structures are possible.



C—Cl bond acquires a partial double bond character due to resonance. As a result, the bond cleavage in haloarene is difficult than haloalkane and therefore, are less reactive towards nucleophilic substitution reaction.

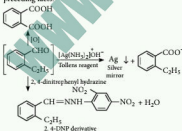
(ii) In haloarenes, halogen is attached to sp^2 -hybridised carbon while in haloalkanes, halogen is attached to sp^3 -hybridised carbon.

17. (i) $\text{C}_6\text{H}_{10}\text{O}$ is an aldehyde because it forms a 2,4-DNP derivative and reduces Tollens' reagent.

(ii) Since $\text{C}_6\text{H}_{10}\text{O}$ undergoes Cannizzaro reaction, the $-\text{CHO}$ group is attached directly to the benzene ring.

(iii) Formation of 1, 2-benzenedicarboxylic acid on vigorous oxidation indicates that it must be an *ortho* alkyl-substituted benzaldehyde.

(iv) This *o*-alkyl-substituted aromatic aldehyde may be assigned the following structure, which explains all the preceding facts.



18. (i) Most of the heart attacks are due to blood clotting in the coronary arteries. Aspirin helps to make the blood thinner and thus prevents the formation of blood clots in the coronary arteries thereby preventing heart attacks.

(ii) Diabetic patients do not produce enough insulin to metabolise the natural sugar. As a result, sugar remains in the blood and thus affects liver, heart and kidneys. Therefore, diabetic patients are advised to take artificial sweeteners such as saccharin. It is not metabolised in the body and is excreted as such through urine.

(iii) Soaps have straight hydrocarbon chains which are easily degraded by bacteria present in the sewage water and hence do not cause water pollution. On the other hand, detergents have branched hydrocarbon chains which are either not attacked or attacked only slowly by bacteria. As a result, detergents remain undegraded in rivers and waterways and thus cause water pollution.

19. (i) Insulin controls the metabolism of glucose in the body and maintains glucose level in the blood.

(ii) **Structural differences**: The main structural differences between DNA and RNA are as follows:

(a) The sugar moiety present in DNA is

β -D-2-deoxyribose, whereas in RNA molecule, it is β -D-ribose.

(b) DNA has a double stranded helical structure, while RNA has a single stranded helical structure.

(c) DNA contains cytosine and thymine as pyrimidine bases, whereas RNA has cytosine and uracil as pyrimidine bases.

Functional difference: DNA controls the transmission of hereditary character while RNA controls the synthesis of proteins.

OR

(a) These are called anomers.

(b) They cannot be called enantiomers as they are not the mirror images of each other.

(c) The laevorotatory mixture of D-(+)-glucose and D-(-)-fructose obtained by the hydrolysis of sucrose is known as invert sugar.

20. For 1st order reaction, $k = \frac{0.693}{t_1/2}$

$$(a) \therefore \text{At } 27^\circ\text{C } k_1 = \frac{0.693}{30} = 2.31 \times 10^{-2} \text{ minute}^{-1}$$

$$\text{At } 47^\circ\text{C } k_2 = \frac{0.693}{10} = 6.93 \times 10^{-2} \text{ minute}^{-1}$$

$$(b) \text{ Now, } 2.303 \log_{10} \frac{k_2}{k_1} = \frac{E_a}{R} \left[\frac{T_2 - T_1}{T_1 T_2} \right]$$

$$\therefore 2.303 \log_{10} \frac{6.93 \times 10^{-2}}{2.31 \times 10^{-2}} = \frac{E_a}{8.314} \times \frac{[320 - 300]}{320 \times 300}$$

$$\therefore E_a = 43840 \text{ J mol}^{-1} \text{ or } E_a = 43.84 \text{ kJ mol}^{-1}$$

(c) For a reaction $E_{a, \text{rev}} - E_{a, \text{fwd}} = \Delta H$

$$\therefore 43.84 - E_{a, \text{rev}} = -50.0 \text{ or } E_{a, \text{rev}} = 43.84 + 50.0 = 93.84 \text{ kJ mol}^{-1}$$

OR

(i) For a first order reaction, $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$

Given : $t = 15 \text{ min}$, $R = 0.8[R]_0$

$$\text{or, } k = \frac{2.303}{15} \log \frac{[R]_0}{0.8[R]_0}$$

$$\text{or, } k = \frac{2.303}{15} \log \frac{10}{8} \quad \dots(1)$$

$$\text{or, } k = 0.015 \text{ min}^{-1}$$

(ii) When $[R] = 0.1 [R]_0$, $t = ?$

$$k = \frac{2.303}{t_1} \log \frac{[R]_0}{0.1[R]_0} = \frac{2.303}{t_1} \log 10 \quad \dots(2)$$

$$\text{or, } 0.015 \text{ min}^{-1} = \frac{2.303}{t_1} \text{ or, } t_1 = \frac{2.303}{0.015 \text{ min}^{-1}}$$

$$t_1 = 153.53 \text{ min}$$

\therefore After 153.53 min, 10% of the original material remains unreacted.

(iii) Also,

$$k = \frac{2.303}{t_2} \log \frac{0.8[R]_0}{0.64[R]_0} = \frac{2.303}{t_2} \log \frac{10}{8} \quad \dots(3)$$

From (1) and (3)

$$\frac{2.303}{15} \log \frac{10}{8} = \frac{2.303}{t_2} \log \frac{10}{8}$$

$$\therefore t_2 = 15 \text{ min}$$

21. (i) The combination of the two layers (fixed and diffused) of opposite charges around the colloidal particles is called Helmholtz electrical double layer.

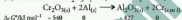
(ii) Dialysis is used for purification of colloidal solutions. It is carried out by putting impure colloidal solution in a parchment paper bag and then dipping it in distilled water. After some time, all the crystalloids in solution diffuse through the membrane into the water leaving behind the pure colloidal solution. An important application of dialysis is during the purification of blood in the artificial kidney machine.

(iii) Physical adsorption involves van der Waals' forces, so any number of layers may be formed one over the other on the surface of the adsorbent. Chemical adsorption takes place as a result of the reaction between adsorbent and adsorbate. When the surface of

adsorbent is covered with one layer, no further reaction can take place.

22. (i) Froth floatation method is used for the concentration of sulphide ores because surface of sulphide ores is preferentially wetted by oil while that of gangue is preferentially wetted by water.

(ii) Reduction of Cr_2O_3 by Al (Thermite process) is



$$\Delta_f G^\circ / \text{kJ mol}^{-1} \quad -500 \quad 0 \quad -827 \quad 0$$

Gibbs energy change for the reduction reaction would be

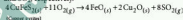
$$\Delta_r G^\circ = -827 - (-500) = -287 \text{ kJ mol}^{-1}$$

Negative value of $\Delta_r G^\circ$ suggests that the reaction is spontaneous and will occur. However, to initiate the reaction, high temperature is required. Once the reaction starts it goes to completion.

OR

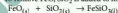
(i) The role of depressant in froth floatation process is to prevent some of the sulphide from forming the froth. e.g., NaCN is used as depressant in the purification of PbS in presence of ZnS.

(ii) During the metallurgy of copper from copper pyrites, CuFeS_2 , its roasting gives FeO besides Cu_2O and SO_2 respectively.



(Copper pyrites)

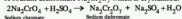
To remove FeO, SiO_2 is added to form slag.



(Basic oxide) (Acidic oxide) (Slag)

(iii) Purified alumina (Al_2O_3) is mixed with cryolite (Na_3AlF_6) which lowers the melting temperature of electrolyte and also increase its conductivity.

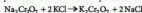
23. The yellow solution of sodium chromate is acidified with sulphuric acid to give a orange solution of sodium dichromate $\text{Na}_2\text{Cr}_2\text{O}_7$ which is crystallised.



Sodium chromate

Sodium dichromate

The solution of sodium dichromate is treated with potassium chloride to obtain potassium dichromate.



Potassium dichromate

Effect of pH : On increasing the pH of $\text{K}_2\text{Cr}_2\text{O}_7$ solution, the dichromate ion changes to chromate ion or vice versa.



Orange

Yellow

24. (i) In CO both lone pair of electrons and vacant π^* -orbitals are present. Hence, it acts as electron pair σ -donor as well as π -acceptor by back bending. Hence, $M \equiv \text{CO}$ bond is stronger.

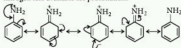
NH_3 is electron pair donor only. Accumulation of negative charge on the metal ion takes place, hence $\text{M}-\text{NH}_3$ bond is weaker.

(ii) Stability constant of each step of complex formation reaction is called stepwise stability constant. It is denoted by K . Stability constant of overall complex formation reaction is called overall stability constant. It is denoted by β . The stepwise and overall stability constant are therefore related as follows:

$$\beta_4 = K_1 \times K_2 \times K_3 \times K_4 \text{ or more generally,}$$

$$\beta_n = K_1 \times K_2 \times K_3 \times K_4 \dots K_n$$

25. (i) In case of aniline, the lone pair of electrons on the N-atom is delocalized with the π -electrons of the benzene ring, making the lone pair of electrons on nitrogen less available for protonation.



On the other hand, in methylamine the electron-releasing methyl group increases the electron density around nitrogen, thereby increasing the availability of the lone pair of electrons.



Therefore, aniline is a weaker base than methylamine and hence its $\text{p}K_b$ value is higher than that of methylamine.

(ii) Methylamine accepts a proton from water and liberates the OH^- ion because it is a stronger base than water.

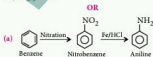


The OH^- ion reacts with the Fe^{3+} ions of the solution to form a brown precipitate of hydrated ferric oxide.

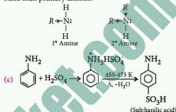


Hydrated ferric oxide
(brown ppt.)

(iii) Gabriel phthalimide synthesis is the only method used to make primary amines because it is not possible to alkylate potassium phthalimide with either $(\text{CH}_3)_2\text{CH}-\text{X}$ or $(\text{CH}_3)_3\text{C}-\text{X}$.



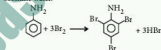
(b) In a primary amine only one alkyl group is attached to N atom while in a secondary amine two alkyl groups are attached to N atom. So, electron density on N atom is more in a secondary amine than in a primary amine due to +I effect of alkyl groups. Secondary amines can donate electron pair more easily and hence are more basic than primary amines.



(d) It is used to manufacture

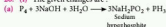
(i) dyes (ii) drugs.

(e) Aniline gives white or brown precipitate with bromine water.

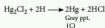
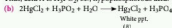


Ethylamine does not react with bromine water

26. (i) The given changes are:



Thus, acid A is H_3PO_2 , i.e., hypophosphorous acid.



(iii) Phosphorus (P_4) is getting oxidised to NaH_2PO_2 and also getting reduced to PH_3 such reactions are called disproportionation reactions.

OR

(a) (i) PH_3 and NH_3 both are Lewis bases, since they have a lone pair of electrons on 'N' and 'P' atom respectively.



Because size of P is larger than N atom, therefore N atom carries more negative charge density than carried by P. Hence NH_3 has more proton affinity than PH_3 .

(ii) Nitrogen has less molecular mass than phosphorus. Two nitrogen atoms are held together by tri-covalent bonding $\text{N} \equiv \text{N}$.

On the other hand phosphorus molecules are tetratomic. Phosphorus molecules have higher molecular mass than nitrogen molecules.

Hence, N_2 is a gas whereas phosphorus is a solid.

(iii) The O atom in Cl_2O is sp^3 -hybridized and its structure is similar to that of OF_2 .

In ClO_2 , the centre Cl atom is sp^2 -hybridized with $\text{O}-\text{Cl}-\text{O}$ angle of 118° . Both the $\text{Cl}-\text{O}$ bonds have equal (149 pm) bond lengths and are quite shorter than those in Cl_2O (171 pm). Therefore $\text{Cl}-\text{O}$ bond, has appreciable double bond character due to $p\pi-d\pi$ bonding.



(b) (i) Copper reacts with dil. HNO_3 to give NO while with concentrated HNO_3 to give NO_2 .



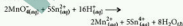
(ii) Zinc reacts with dilute nitric acid to give N_2O while with conc. HNO_3 to give NO_2 .



27. (i) At anode: $\text{Sn}^{2+}_{(\text{aq})} \rightarrow \text{Sn}^{4+}_{(\text{aq})} + 2e^- \times 5$

At cathode: $\text{MnO}^{2+}_{(\text{aq})} + 8\text{H}^{+}_{(\text{aq})} + 5e^- \rightarrow \text{Mn}^{2+}_{(\text{aq})} + 4\text{H}_2\text{O}_{(\text{l})} \times 2$

Net cell reaction:



$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} \text{ or, } 1.51 \text{ V} - 0.15 \text{ V} = 1.36 \text{ V}$$

Since, cell potential is positive therefore the reaction is product favoured.

(ii) Reaction for deposition of Mg from molten MgCl_2 :



24 g of Mg is deposited by 2×96500 C of electricity

\therefore 1.2 g of Mg will be deposited by

$$\frac{2 \times 96500}{24} \times 1.2 = 9650 \text{ C of electricity}$$

Now, $Q = It$

$$\therefore I = \frac{Q}{t} = \frac{9650}{60 \times 60} = 2.68 \text{ A}$$

OR

(a) (i) The cell reactions are:

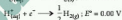


Net reaction:



(iii) Copper electrode will be positive on which reduction takes place.

(b) (i) At cathode: The following reduction reactions compete to take place at the cathode.



The reaction with a higher value of E° takes place at the cathode. Therefore, the deposition of silver will take place at the cathode.

Since, Pt electrodes are inert, the anode is not attacked by NO_3^- ions. Therefore, OH^- or NO_3^- ions can be oxidized at the anode. But OH^- ions having a lower discharge potential get preference and decompose to liberate O_2 .



(ii) At the cathode, the following reduction reaction occurs to produce H_2 gas.



At the anode, the following processes are possible:



For dilute sulphuric acid, reaction (1) is preferred to produce O_2 gas but for concentrated sulphuric acid, (2) occurs.



BRUSH UP YOUR CONCEPTS

**Class
XII**

This specially designed column will help you to brush up your concepts by practicing questions. You can mail us your queries and doubts related to this topic at editor@mg.in. The queries will be entertained by the author.*

CHEMICAL KINETICS

- The change in molarity of a reactant or a product in unit time is called rate of reaction.

For $aA \rightarrow bB$,

$$\text{Average rate of consumption of } A = -\frac{\Delta[A]}{\Delta t}$$

$$\text{Average rate of production of } B = +\frac{\Delta[B]}{\Delta t}$$

$$\text{Average rate of reaction} = -\frac{1}{a} \frac{\Delta[A]}{\Delta t} = +\frac{1}{b} \frac{\Delta[B]}{\Delta t}$$

Instant rate of consumption of A

$$= -\lim_{\Delta t \rightarrow 0} \frac{\Delta[A]}{\Delta t} = -\frac{d[A]}{dt}$$

Instant rate of production of B

$$= +\lim_{\Delta t \rightarrow 0} \frac{\Delta[B]}{\Delta t} = +\frac{d[B]}{dt}$$

$$\text{Instant rate of reaction} = -\frac{1}{a} \frac{d[A]}{dt} = +\frac{1}{b} \frac{d[B]}{dt}$$

- Rate of a reaction is affected by the nature of reactants, their concentration or pressure, surface area, temperature, catalyst and effect of light.
- For the reaction, $aA + bB \rightarrow \text{Products}$. Experimentally, rate $(r) = k[A]^x[B]^y$ [Rate law]
 - If x and y are equal to a and b respectively, the reaction is a single step (elementary reaction) otherwise it has some mechanism.
 - x and y are orders of reaction w.r.t. A and B and $x + y$ is the net order of the reaction.
 - k is the rate constant and has a fixed value at a given temperature. Increase in temperature increases the value of k . Faster reactions have higher value of k .
 - Order can be +ve, -ve, whole number or a fraction.

- Zero order reactions :**

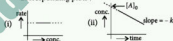
- Reaction of H_2O_2 and Cl_2O in diffused sunlight.
- Decomposition of NH_4Cl over Pt, W, Au, etc. at high pressure.
- One free radical reacts with another.

For a zero order reaction, $A \rightarrow \text{Products}$

$$-\frac{d[A]}{dt} = k[A]^0 \quad \dots(i)$$

$$[A] = -kt + [A]_0 \quad \dots(ii)$$

Corresponding plots :



$$k = \frac{[A]_0 - [A]}{t} = \frac{x \text{ (consumption, mol l}^{-1}\text{)}}{t \text{ (time)}} \quad \dots(iii)$$

$$t_{1/2} = \frac{[A]_0}{2k} \quad \dots(iv)$$

$$\text{For } t_{100\%}, [A] = 0; \quad t_{100\%} = \frac{[A]_0}{k} = 2t_{1/2}$$

- First order reactions :**

- All nuclear disintegrations
- Thermal decomposition of $N_2O_5(g)$, $H_2O_2(l)$ and $NH_4NO_2(s)$
- Growth of population if rate of birth and rate of death do not change.

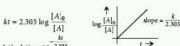
For a first order reaction,
 $A \rightarrow \text{Products}$

$$-\frac{d[A]}{dt} = k[A]$$

$$kt = \ln \frac{[A]_0}{[A]}; [A] = [A]_0 e^{-kt};$$



*By R.C. Grover, having 45+ years of experience in teaching chemistry.



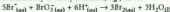
$$[A] = [A]_0 \times 10^{-\frac{kt}{2.303}}$$

$$t_{1/2} = \frac{2.303}{k} \log \frac{[A]_0}{[A]_0/2} = \frac{2.303 \log 2}{k} = \frac{0.693}{k}$$

$t_{1/2}$ is independent of initial concentration.

- $t_{1/2}$ is always proportional to $[A]_0^{-1/n}$.
- Pseudo first order reaction**: If the molecularity of balanced equation of reaction is not one but the rate law has first order with respect to any one reactant while other reactants do not appear in the rate law, the reaction is pseudo first order reaction. e.g., hydrolysis of ester, inversion of cane sugar, etc.
- For determination of order of reaction, integrated rate law, simple rate law (Ostwald isolation method) or initial concentration method can be applied.
- The number of molecules of reacting species that collide simultaneously to bring about a chemical reaction is called its molecularity.

Common molecularities are 1, 2 or 3. Higher molecularity is rarely available, e.g., 12 for



- Units of rate constant: $\text{mol}^{1-n} \text{L}^{n-1} \text{s}^{-1}$
- Effect of temperature on rate of reaction**: Arrhenius theory,

$$\text{Temperature coefficient, } \mu = \frac{k_{(T+10)}{k_T} = 2 \text{ (generally)}$$

$$\frac{\text{new rate}}{\text{old rate}} = (\mu)^{\frac{\Delta T}{10}}$$

Fraction of molecules $\left(\frac{n}{N}\right)$ having received energy equal to or more than E_a (activation energy) at temperature T (kelvin) was given by Arrhenius. Here, A is Arrhenius factor.

$$\frac{n}{N} = \frac{k}{A} = e^{-\frac{E_a}{RT}} \Rightarrow k = A e^{-\frac{E_a}{RT}}$$

$e^{-\frac{E_a}{RT}}$ or $\frac{n}{N}$ is called Boltzmann factor.

- T cannot be extremely high, that will give $k = A$, i.e., all collisions produce products, which is not possible.
- E_a cannot be zero. It will again give $k = A$ as in (a).
- E_a cannot be less than zero. It will give $k > A$ which is impossible.

$$\text{Taking logarithm, } \ln k = \ln A - \frac{E_a}{RT}$$

$$\text{Also, } \log k = -\frac{E_a}{2.303RT} + \log A$$



At two different temperatures T_1 and T_2 where $T_2 > T_1$

$$\text{and } \frac{k_2}{k_1} = \frac{r_2}{r_1}$$

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$E_a = \frac{2.303R T_1 T_2}{T_2 - T_1} \log \frac{k_2}{k_1}$$

$$\text{Effect of catalyst: } \frac{k_{cat}}{k} = (e)^{\frac{(E - E_a) RT}{RT}} = (e)^{\frac{\Delta E RT}{RT}}$$

$$\Delta E = 2.303RT \log \frac{k_{cat}}{k}$$

- Collision theory**: Rate = $PZ e^{-\frac{E_a}{RT}}$
 P is probability for effective collisions.
 Z is collision frequency (number of collisions per unit volume per second).

MULTIPLE CHOICE QUESTIONS

1. For the reaction, $A + B \rightarrow \text{Products}$, it was found that 75% consumption of A needs double the time for 50% consumption. Regarding B , the time for 100% consumption is double that of its half life. The net order of reaction is

- (a) 1.0 (b) 1.5 (c) 2.0 (d) 2.5

2. For a reaction, instantaneous rate of reaction is

$$-\lim_{\Delta t \rightarrow 0} \frac{\Delta[A]}{\Delta t}. \text{ What does the negative sign show?}$$

- Increase in concentration of substance A .
- Decrease in concentration of substance A .
- Concentration of substance does not change.
- The approach of Δt to zero is extremely slow.

3. Which of the following is not compulsorily increasing the rate of reaction?

- Increase in concentration of reactant
- Increase in surface area of reactant
- Increase in temperature of the reaction mixture
- Increase in wavelength of light falling on the mixture

4. Which of the following is not correct for rate constant?

- It has a fixed value for a given temperature.
- Higher the initial concentration, higher is the rate constant.
- Higher is the value of rate constant, faster is the reaction.
- Units of rate constant depend upon units of time and concentration and the order of reaction.

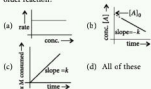
5. Which of the following is not correct for order of reaction?

- (a) It is an experimental factor.
 (b) For elementary reactions, it is the sum of coefficients in the balanced reaction.
 (c) Order can never be negative.
 (d) Order of reaction can be a fraction also.

6. For a zero order reaction,

- (a) $t_{75\%} = 2t_{50\%}$ (b) $t_{100\%} = 2t_{50\%}$
 (c) $t_{50\%} = \frac{0.693}{k}$ (d) $kt = 2.303 \log \frac{[A]_0}{[A]}$

7. Which of the following plots is correct for a zero order reaction?



8. For the reversible reaction: $H_2 + I_2 \xrightleftharpoons[k_2]{k_1} 2HI$, the net rate of formation of HI is

- (a) $2k_1[H_2][I_2]$ (b) $2k_1[H_2][I_2] - k_2[HI]^2$
 (c) $k_1[H_2][I_2] - 2k_2[HI]^2$ (d) $2k_1[H_2][I_2] - 2k_2[HI]^2$

9. For a single step reaction: $aA + bB \rightarrow \text{Products}$, which of the following is incorrect?

- (a) Rate law, $r = k[A]^x[B]^y$
 (b) Rate of reaction, $r = k[A]^x[B]^y$, where $x \neq a, y \neq b$
 (c) According to law of mass action, $r = [A]^a[B]^b$
 (d) If B is in large excess, the net order of reaction is 'a'.

10. The rate constant of a reaction is $3.6 \times 10^{-3} \text{ L mol}^{-1} \text{ s}^{-1}$. The order of reaction is

- (a) 0 (b) 1 (c) 2 (d) 3

11. 5% of a reaction is completed in 1 hr, 10% in 2 hr and 15% in 3 hr. The order of reaction is

- (a) 0 (b) 1 (c) 2 (d) 3

12. For the reaction, $aA + bB \rightarrow \text{Products}$, the rate increases by 8 times when concentrations of both A and B are doubled but on changing the concentration of only A to double, the rate is also doubled. The units of rate constant will be

- (a) hr^{-1} (b) $\text{mol L}^{-1} \text{ hr}^{-1}$
 (c) $\text{L mol}^{-1} \text{ hr}^{-1}$ (d) $\text{mol}^{-2} \text{ L}^2 \text{ hr}^{-1}$

13. The rate of production of NH_3 from its elements by Haber's process is $6 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$. The rate of consumption of hydrogen gas would be

- (a) $\frac{1}{3} \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$
 (b) $9 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$
 (c) $3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
 (d) $\frac{1}{9} \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$

14. For the reaction, $2\text{N}_2\text{O}_5 \rightleftharpoons 2\text{N}_2\text{O}_4 + \text{O}_2$

- (i) $-\frac{d[\text{N}_2\text{O}_5]}{dt} = k_1[\text{N}_2\text{O}_5]$
 (ii) $+\frac{d[\text{N}_2\text{O}_4]}{dt} = k_2[\text{N}_2\text{O}_5]$
 (iii) $+\frac{d[\text{O}_2]}{dt} = k_3[\text{N}_2\text{O}_5]$

Which of the following relations is correct?

- (a) $k_1 = k_2 = k_3$ (b) $k_1 = k_2 = \frac{1}{2}k_3$
 (c) $\frac{1}{2}k_1 = \frac{1}{2}k_2 = k_3$ (d) $\frac{1}{4}k_1 = \frac{1}{4}k_2 = k_3$

15. (i) $P + Q \xrightarrow{\text{fast}} A$ (fast)

(ii) $A + R \xrightarrow{\text{slow}} B$ (slow)

(iii) $B + Q \xrightarrow{\text{fast}} S + T$ (fast)

are elementary steps of the reaction,

$2P + Q + 3R \rightarrow S + T$.

The rate law of the reaction is

- (a) $r = k[P][Q]$ (b) $r = k[P]^2[Q][R]^3$
 (c) $r = k[P]^{1/2}[Q][R]^{1/3}$ (d) $r = k[P][Q][R]$

16. The ratio of time for 50% and 90% completion of a first order reaction is

- (a) 1 : 2 (b) 2 : 3 (c) 3 : 5 (d) 3 : 10

17. Half life of a radioisotope is 3 hr. If the initial mass of isotope is 256 g, the mass undecayed after 18 hours is

- (a) 4.0 g (b) 8.0 g (c) 16.0 g (d) 32.0 g

18. The rate of a reaction is doubled for every 10°C rise in temperature. What is the rate of reaction will become if the temperature is raised from 300 K to 390 K?

- (a) 32 times (b) 128 times
 (c) 512 times (d) 9 times

19. If the volume of container is decreased to $\frac{1}{3}$ rd of the original volume, by how much will the rate of the reaction, $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$, change?

- (a) 9 times increase (b) 9 times decrease
 (c) 27 times increase (d) 27 times decrease

20. Which of the following plots can be used for determining the activation energy of a reaction?

- (a) $\log k$ vs $\frac{1}{T}$ (b) $\log k$ vs T
 (c) k vs T (d) k vs $\frac{1}{T}$

21. It takes just 5 minutes for evolution of 25 mL of O_2 gas from first order decomposition of H_2O_2 . The reaction ends with evolution of 100 mL of O_2 gas. The rate constant of decomposition of H_2O_2 is

- (a) 0.077 (b) 0.177 (c) 0.277 (d) 0.377

22. For two reactions at the same temperature $k_1 \gg k_2$. How are their activation energies, E_1 and E_2 related?

- (a) $E_1 = E_2$ (b) $E_1 > E_2$
 (c) $E_1 < E_2$
 (d) Data is insufficient to decide.

23. From the following data of initial rate of formation of C mol $L^{-1} s^{-1}$, decide the rate law of the reaction, $2A + 3B \rightarrow C + 2D$.

Initial [A]	Initial [B]	Initial rate of formation of C
0.1 M	0.1 M	$1.2 \times 10^{-3} M s^{-1}$
0.1 M	0.2 M	$1.2 \times 10^{-3} M s^{-1}$
0.2 M	0.1 M	$2.4 \times 10^{-3} M s^{-1}$

- (a) $\frac{dC}{dt} = k[A]$ (b) $\frac{dC}{dt} = k[A][B]^2$
 (c) $\frac{dC}{dt} = k[A]$ (d) $\frac{dC}{dt} = k[A][B]$

24. It takes 40 minutes for 50% decomposition of a substance. When the quantity of the substance is reduced to half it takes 20 minutes. The order of reaction is

- (a) zero (b) 1
 (c) 2 (d) 1.5

25. The rate of a reaction doubles when the temperature is changed from 300 K to 310 K. Activation energy of the change is $[R = 8.314 J K^{-1} mol^{-1}, \log 2 = 0.301]$

- (a) 53.6 kJ mol^{-1} (b) 48.6 kJ mol^{-1}
 (c) 58.5 kJ mol^{-1} (d) 60.5 kJ mol^{-1}

SOLUTIONS

1. (a): Order w.r.t. A is one because $t_{75\%} = 2t_{50\%}$
 Order w.r.t. B is zero because $t_{100\%} = 2t_{50\%}$

2. (b)

3. (d): Light of specific wavelength or white light is generally needed.

4. (b): Initial concentration has to do nothing with the value of rate constant.

5. (c): Order of reaction can be negative also. e.g., order of reaction: $2O_3 \rightarrow 3O_2$ is -1 w.r.t. O_2

$$\text{rate} = k[O_3]^2 [O_2]^{-1}$$

6. (b)

7. (d)



$$\begin{aligned} \text{Rate of reaction w.r.t. HI} &= \frac{1}{2} \frac{d[HI]}{dt} \\ &= k_1[H_2][I_2] - k_2[HI]^2 \\ &\quad \text{(Formation)} \quad \text{(Decomposition)} \end{aligned}$$

$$\Rightarrow \frac{d[HI]}{dt} = 2k_1[H_2][I_2] - 2k_2[HI]^2$$

9. (b): For the reaction being a single step reaction, $r = k[A]^x [B]^y$.

10. (c): For n^{th} order reaction, $k = \frac{r}{[A]^n}$
 \Rightarrow Units of $k = (\text{mol } L^{-1} s^{-1}) (L^n \text{ mol}^{-n})$
 $= \text{mol}^{1-n} L^{n-1} s^{-1}$

$$\text{Given, } k = 3.6 \times 10^{-5} L \text{ mol}^{-1} s^{-1}$$

Compare power of L, $n-1 = 1 \Rightarrow n = 2$
 or Directly add 1 to the power of litre in given unit to get order of reaction.

11. (a): Percentage composition \propto time

\Rightarrow Order of reaction = zero

12. (d): Let $r = k[A]^x [B]^y$... (i)

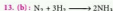
1st case: $8r = k[2A]^x [2B]^y$... (ii)

2nd case: $2r = k[2A]^x [B]^y$... (iii)

$$(iii) \div (i); 2 = (2)^x \Rightarrow x = 1$$

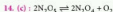
$$(ii) \div (iii); 4 = (2)^y \Rightarrow y = 2$$

$$\text{Net order} = 3 \Rightarrow \text{units of } k = L^2 \text{ mol}^{-2} \text{ hr}^{-1}$$



$$-\frac{1}{3} \frac{d[H_2]}{dt} = \frac{1}{2} \frac{d[NH_3]}{dt}$$

$$-\frac{d[H_2]}{dt} = \frac{3}{2} \times 6 \times 10^{-3} \text{ mol } L^{-1} s^{-1} = 9 \times 10^{-3} \text{ mol } L^{-1} s^{-1}$$



$$-\frac{1}{2} \frac{d[N_2O_5]}{dt} = \frac{1}{2} \frac{d[N_2O_4]}{dt} = \frac{d[O_2]}{dt}$$

$$\frac{1}{2} k_1[N_2O_5] = \frac{1}{2} k_2[N_2O_5] = k_3[N_2O_5]$$

$$\Rightarrow \frac{1}{2} k_1 = \frac{1}{2} k_2 = k_3$$

15. (d): From slow step: $A + R \rightarrow B$

$$r = k_3[A][R] \quad \dots (1)$$

For $P + Q \rightleftharpoons A$

$$\frac{[A]}{[P][Q]} = K \Rightarrow [A] = K[P][Q]$$

from (1) and (2), $r = k_1 K[P][Q] = [R]$

$$\Rightarrow r = k[P][Q][R]$$

$$16. (d) : t_{50\%} = \frac{2.303}{k} \log \frac{100}{50} = \frac{2.303 \times 0.3010}{k}$$

$$t_{90\%} = \frac{2.303}{k} \log \frac{100}{10} = \frac{2.303}{k}$$

$$\frac{t_{50\%}}{t_{90\%}} = \frac{\frac{2.303 \times 0.301}{k}}{\frac{2.303}{k}} = 3:10$$

$$17. (a) : \text{Amount left} = \frac{\text{Initial amount}}{(2)^{\text{No. of half lives}}}$$

$$n = \frac{18}{3} = 6 \text{ half lives} \Rightarrow 2^n = 2^6 = 64$$

$$\text{Amount left} = \frac{256}{64} = 4 \text{ g}$$

$$18. (c) : \frac{\text{New rate}}{\text{Old rate}} = (2)^{\left(\frac{\Delta T}{10}\right)} = (2)^3 = 512$$

19. (c) : Decrease in volume by $\frac{1}{3}$ rd will increase the concentration by 3 times.

$$r = k[\text{NO}]^2 [\text{O}_2] \text{ and } r' = k[\text{3NO}]^2 [\text{3O}_2]$$

$$\frac{r'}{r} = (3)^2 \times (3) = 27 \text{ times increase}$$

$$20. (a) : \frac{k}{A} = e^{-\frac{E_a}{RT}} \Rightarrow \log_e \frac{k}{A} = -\frac{E_a}{RT}$$

$$\Rightarrow \log k - \log A = -\frac{E_a}{2.303R} \times \frac{1}{T}$$

$$\Rightarrow \log k = \left(-\frac{E_a}{2.303R}\right) \times \frac{1}{T} + \log A$$

$$\dots(2) \text{ Slope of graph between } \log k \text{ and } \frac{1}{T} \text{ is } -\frac{E_a}{2.303R}$$

$$21. (c) : k = \frac{2.303}{t} \log \frac{[A]_0}{[A]} = \frac{2.303}{5} \log \frac{100}{25}$$

$$= \frac{2.303}{5} \times 0.6021 = 0.277$$

$$22. (c) : k = Ae^{-\frac{E_a}{RT}}$$

Lower the value of E_a , higher is the value of k .

Hence, for k_1, k_2 we have $E_1 < E_2$.

$$23. (c) : r = k[A]^x [B]^y$$

$$1.2 \times 10^{-3} = k [0.1]^x [0.1]^y \dots(i)$$

$$1.2 \times 10^{-3} = k [0.1]^x [0.2]^y \dots(ii)$$

$$2.4 \times 10^{-3} = k [0.2]^x [0.1]^y \dots(iii)$$

$$(ii) \div (i), 1 = 2^y \Rightarrow y = 0$$

i.e., B should not appear in rate law.

$$(iii) \div (i), 2 = 2^x \Rightarrow x = 1$$

$$\text{Hence, rate law} = \frac{d[C]}{dt} = k[A]$$

$$24. (a) : t_{1/2} \propto [A]^{1-n}$$

$$40 = (x)^{1-n} \text{ and } 20 = \left(\frac{x}{2}\right)^{1-n}$$

$$\frac{40}{20} = \left(\frac{x}{x/2}\right)^{1-n} \Rightarrow 2 = 2^{1-n}$$

$$1 - n = 1 \text{ or } n = 0$$

$$25. (a) : \log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$\log \frac{2}{1} = \frac{E_a}{2.303 \times 8.314} \left[\frac{1}{300} - \frac{1}{310} \right]$$

$$E_a = 53598.6 \text{ J mol}^{-1} = 53.6 \text{ kJ mol}^{-1}$$

COMIC CAPSULE



Mr. Noble Gas, why are you so sad?



Because all my friends Argon!



Class XII

MONTHLY
TUNE UP!

PRACTICE PROBLEMS

These practice problems enable you to self analyse your extent of understanding of specified chapter. Give yourself four marks for correct answer and deduct one mark for wrong answer. Performance analysis table given at the end will help you to check your readiness.

Aldehydes, Ketones and Carboxylic Acids

Total Marks : 120

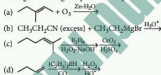
Time Taken : 60 Min.

NEET / AIIMS

Only One Option Correct Type

1. A carbonyl compound reacts with hydrogen cyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of α -hydroxy acid. The carbonyl compound is
- (a) acetone (b) diethyl ketone
(c) formaldehyde (d) acetaldehyde.

2. All of the following reactions give at least one ketone as a significant organic product except

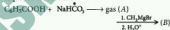


3. $\text{C}_6\text{H}_5\text{COCl} \xrightarrow[\text{H}_2]{\text{Pd-BaSO}_4} \text{A} \xrightarrow{\text{Oxidation}} \text{B} \xrightarrow[\text{Dry distillation}]{\text{Ca-salt}} \text{C}$

Compound (C) in above reaction sequence is

- (a) benzophenone (b) benzaldehyde
(c) acetophenone (d) benzoquinone.
4. During cross aldol condensation of ethanal and propanal, the product which is not formed is
- (a) 3-hydroxy-2-methyl pentanal
(b) 3-hydroxy-2-methyl butanal
(c) 2-hydroxy-3-methyl pentanal
(d) 3-hydroxy butanal.

5. Identify the final product (B) of the following sequence of reactions.



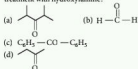
- (a) $\text{C}_6\text{H}_5\text{COOH}$ (b) $\text{C}_6\text{H}_5\text{COOH}$
(c) CH_3COOH (d) HCOOCH_3

6. In the following sequence of reactions, the final product (Y) is



- (a) (b)
(c) $\text{CH}_3\text{CO}(\text{CH}_2)_4\text{CHO}$
(d) $\text{CH}_3\text{CHOH}(\text{CH}_2)_4\text{CH}_2\text{OH}$

7. Which of the following gives more than one oxime on treatment with hydroxylamine?

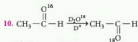
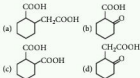


8. Identify the final product (Z) in the following sequence of reactions :

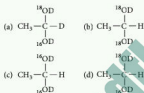


- (a) $(\text{CH}_3)_2\text{C}(\text{OH})\text{COOH}$
 (b) $\text{CH}_2=\text{C}(\text{CH}_3)\text{COOH}$
 (c) $\text{HOCH}_2\text{CH}(\text{CH}_3)\text{COOH}$
 (d) $\text{CH}_3\text{CH}=\text{CHCOOH}$

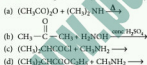
9. The compound that undergoes decarboxylation most readily under mild conditions is











The intermediate is



11. Which reaction given below produces a tertiary amide?



12. B $\xleftarrow{\text{LiAlH}_4}$  $\xrightarrow{\text{H}_2/\text{Pt}}$ A, then A and B respectively are

- (a)  
 (b)  
 (c)  
 (d)  

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
 (a) if both assertion and reason are true and reason is the correct explanation of assertion.
 (b) if both assertion and reason are true but reason is not the correct explanation of assertion.
 (c) if assertion is true but reason is false.
 (d) if both assertion and reason are false.

13. **Assertion :** Benzaldehyde is more reactive than propanal towards nucleophilic addition reactions.

Reason : Benzaldehyde is less sterically hindered.

14. **Assertion :** $\text{CH}_3\text{COCH}_2\text{COCH}_3$ does not respond to the iodoform test with I_2/OH^- .

Reason : Presence of active methylene group attracts the base.

15. **Assertion :** The product of the reaction is



Reason : The carboxylic acid derivatives undergo acyl substitution.

JEE MAIN / ADVANCED

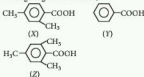
Only One Option Correct Type

16. The correct sequence of reagents to carry out the following conversion:



- (a) (i) $\text{LiAlH}_4/\text{ether}$, (ii) $(\text{CH}_3\text{OH})_2/\text{PTS}$, (iii) H_3O^+
 (b) (i) H_3O^+ , (ii) $(\text{CH}_3\text{OH})_2/\text{PTS}$, (iii) $\text{NaBH}_4/\text{CH}_3\text{OH}$
 (c) (i) $(\text{CH}_3\text{OH})_2/\text{PTS}$, (ii) $\text{NaBH}_4/\text{CH}_3\text{OH}$, (iii) H_3O^+
 (d) (i) $(\text{CH}_3\text{OH})_2/\text{PTS}$, (ii) $\text{LiAlH}_4/\text{ether}$, (iii) H_3O^+

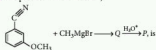
17. Among the given three acids,







the correct order of ease of acid catalysed esterification is

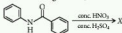
- (a) $X > Z > Y$ (b) $Y > X > Z$
 (c) $Z > X > Y$ (d) $Y > Z > X$

18. The product P in the reaction,







- (a)  (b) 
 (c)  (d) 

19. In the following reaction,



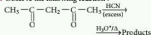
The structure of the major product X is

- (a) 
 (b) 
 (c) 
 (d) 

More than One Options Correct Type

20. Under Wolff-Kishner reduction conditions, the conversions which may be brought about are
 (a) benzophenone into diphenylmethane
 (b) benzaldehyde into benzyl alcohol
 (c) cyclohexanone into cyclohexanol
 (d) cyclohexanone into cyclohexane.


21. Observe the following reaction :







The correct statements are

- (a) the product is a mixture of two compounds
 (b) the product is optically inactive
 (c) the product is a mixture of two chiral and one achiral stereoisomer
 (d) the product is a mixture of three stereoisomers.

22. Acid anhydrides can be prepared by

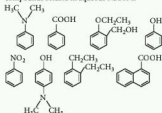
- (a) $\text{C}_6\text{H}_5\text{COOH} + \text{CH}_3\text{COCl} \xrightarrow{\text{Pyridine}}$
 (b) $\text{C}_6\text{H}_5\text{COO}^-\text{Na}^+ + \text{C}_6\text{H}_5\text{COCl} \longrightarrow$
 (c) $\text{CH}_3\text{CONH}_2 + \text{CH}_3\text{COO}^-\text{Na}^+ \longrightarrow$
 (d) 

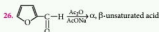
23. Which of the following compounds will give HVZ reaction?

- (a)  (b) 
 (c)  (d) 

Numerical Value Type

24. The number of compounds which will not undergo Cannizzaro reaction on treatment with conc. NaOH solution is
 Methanal, 2-methylpentanal, benzaldehyde, benzophenone, cyclohexanone, phenylpropanone, phenylacetaldehyde, butan-1-ol, 2, 2-dimethylbutanal
 25. Amongst the following the total number of compounds soluble in aqueous NaOH is

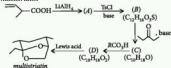




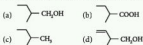
The number of sp^2 hybridised carbons present in α, β -unsaturated acid is

Comprehension Type

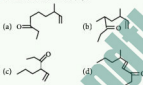
Shown below is a synthesis of elm bark beetle pheromone, multistriatin



27. The structural formula of compound (A) is

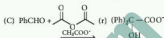
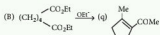


28. Structural formula of (C) is



Matrix Match Type

29. Match the following :



A	B	C	D
(a) q	p	s	r
(b) r	p	q	s
(c) p	q	s	r
(d) s	r	p	q

30. Match the following :

Column I (Reaction)	Column II (Intermediate)
(A) $\text{RCOOH} + \text{N}_3\text{H} \rightarrow \text{RNH}_2$	(p) Six membered cyclic intermediate
(B) $\text{R}-\text{C}(=\text{O})-\text{CH}_2\text{COOH} \xrightarrow{\Delta} \text{R}-\text{C}(=\text{O})-\text{CH}_2\text{COCH}_3$	(q) Carbene
(C) $\text{RCOOAg} + \text{Br}_2 \xrightarrow{\text{OCl}_2} \text{RBr}$	(r) Isocyanate
(D) $\text{RCOOH} + \text{CH}_2\text{N}_2 \xrightarrow{\Delta} \text{RCOOCH}_3$	(s) Free radical

A	B	C	D
(a) q	p	r	s
(b) s	q	p	r
(c) r	p	s	q
(d) p	q	s	r

Keys are published in this issue. Search now! ☺

CHECK YOUR PERFORMANCE

No. of questions attempted
No. of questions correct
Marks scored in percentage

if your score is

> 80%

Your preparation is going good, keep it up to get high score.

60-80%

Need more practice, try hard to score more next time.

< 60%

Stress more on concepts and revise thoroughly.

CHEMISTRY Musing

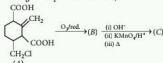
PROBLEM SET 66

Chemistry Musing was started from August '13 issue of Chemistry Today. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET / AIIMS / JIPMER with additional study material. In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today.

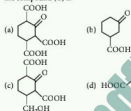
The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue. We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

JEE MAIN/NEET

1. In the given sequence of reactions,



the compound (C) is



2. The following complexes are given :

I. $\text{trans}[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ II. $\text{cis}[\text{Co}(\text{NH}_3)_2(\text{en})_2]^{3+}$

III. $\text{trans}[\text{Co}(\text{NH}_3)_4(\text{en})_2]^{3+}$

IV. NiCl_2^{2-}

V. TiF_6^{2-}

VI. CoF_6^{3-}

Choose the correct option.

- (a) I, II are optically active, III is optically inactive.
 (b) II is optically active, I, III are optically inactive.
 (c) IV, V are coloured and VI is colourless.
 (d) IV is coloured and V, VI are colourless.
3. Calculate the cell potential of following cell:
 $\text{Pt} | \text{H}_2(1 \text{ bar}) | \text{BOH}(0.1 \text{ M aq}) | \text{HA}(0.1 \text{ M}) | \text{H}_2(1 \text{ bar}) | \text{Pt}$
 Given: $K_a(\text{HA}) = 10^{-7}$, $K_b(\text{BOH}) = 10^{-5}$
 (a) 0.38 V (b) 0.45 V (c) 0.93 V (d) 0.63 V
4. Energy required for excitation of 1 mole electron in H atom from ground state to 2nd excited state is

2.67 times lesser than dissociation energy per mole of $\text{H}_{2(g)}$. Calculate the amount of energy needed to excite each H atom of $\text{H}_{2(g)}$ confined in 1.0 litre at 27°C and 1 bar pressure. ($R = 0.083 \text{ bar litre K}^{-1} \text{ mol}^{-1}$; $R_H = 1.1 \times 10^7 \text{ m}^{-2}$)

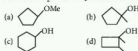
- (a) $2.187 \times 10^2 \text{ J}$ (b) $21.87 \times 10^4 \text{ J}$
 (c) $31.88 \times 10^4 \text{ J}$ (d) $3.188 \times 10^2 \text{ J}$

5. In molecules of the type AX_2L_n , where L represents lone pair, 'n' is number and there exists a bond between elements A and X. Then XAX angle

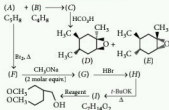
- (a) always decreases when 'n' increases
 (b) does not change with 'n'
 (c) will be maximum for $n = 3$
 (d) will always be less than 180° if $n = 0$.

JEE ADVANCED

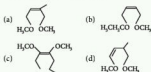
6. An organic compound A ($\text{C}_8\text{H}_{12}\text{O}$) neither decolourises bromine water nor changes the colour of acidic dichromate solution. A on heating with H_2SO_4 produces an alkene which on oxidative ozonolysis gives $\text{B}(\text{C}_6\text{H}_{10}\text{O}_3)$, which gives a yellow precipitate with NaOH/I_2 . The most probable structure of A is



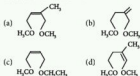
COMPREHENSION



7. The structural formula of (G) is



8. Structural formula of I is



INTEGER VALUE

9. In a certain reaction B^{n+} is getting converted to $B^{(n+4)+}$ in solution. The rate constant of this reaction is measured by titrating a volume of the solution with a reducing agent which reacts only with B^{n+} and $B^{(n+4)+}$. In this process, it converts B^{n+} to $B^{(n-2)+}$ and $B^{(n+4)+}$ to $B^{(n-1)+}$. At $t = 0$, the volume of reagent consumed is 25 mL and at $t = 10$ min, the volume used is 32 mL. The rate constant for the conversion of B^{n+} to $B^{(n+4)+}$ is $x \times 10^{-2}$. Then the value of x is (Assume it to be a first order reaction)
10. How many compounds liberate NH_3 on heating from the following?
 $(NH_4)_2SO_4$, $(NH_4)_2CO_3$, NH_4Cl , NH_4NO_3 ,
 $(NH_4)_2Cr_2O_7$

3 AMAZING FACTS YOU MUST KNOW



Our brain contains about 73% water

The brain and heart are composed of about 73% water and the lungs are about 79% water. The skin contains 72% water, muscles and kidneys are about 79%, and even the bones are watery : 22%.

Generally, an adult male needs about 3 liters per day while an adult female needs about 2.2 liters per day. All of the water a person needs, does not have to come from drinking liquids, as some of this water is contained in the food we eat.

You cannot taste food without saliva

A person cannot taste food unless it is mixed with saliva. For example, if strong-tasting substance like salt is placed on a dry tongue, the taste buds will not be able to taste it. Chemoreceptors in the taste buds of your tongue require a liquid medium in order for the flavors to bind into the receptor molecules. If you don't have liquid, you won't see results. Now, technically you can use water for this purpose rather than saliva. However, saliva contains amylase, an enzyme that acts on sugars and other carbohydrates, so without saliva sweet and starchy foods may taste different from what you expect.



There is about 200 g of table salt (NaCl) in an average adult human body

The human body contains many salts, of which sodium chloride (common table salt) is the major one, making up around 0.4 per cent of the body's weight at a concentration pretty well equivalent to that in seawater. So a 50 kg person would contain around 200 g of sodium chloride – around 40 teaspoons. Since we lose salt whenever we sweat, it has to be continually replaced.

YOU ASK WE ANSWER

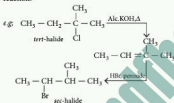
Do you have a question that you just can't get answered?

Use the vast expertise of our MTG team to get to the bottom of the question. From the serious to the silly, the controversial to the trivial, the team will tackle the questions, easy and tough.

The best questions and their solutions will be printed in this column each month.

1. Can we convert tertiary alkyl halide to secondary alkyl halide? *(Chetak Gorai)*

Ans. There is no direct method for the conversion of tertiary alkyl halide to secondary alkyl halide. However, we can convert it by elimination followed by addition reaction.



2. Why is $\Delta S_{\text{sur}} + \Delta S_{\text{sys}} > 0$ for irreversible reaction but $\Delta S_{\text{sur}} + \Delta S_{\text{sys}} = 0$ for reversible reaction?

(Subhadep Mandal, West Bengal)

Ans. Entropy is a thermodynamic function which is a measure of disorder. Entropy always increases in the direction of spontaneous change. All natural processes are spontaneous and irreversible.

For example, consider a system at high temperature T_1 and its surrounding at T_2 . q is the amount of heat goes irreversibly from system to surrounding.

$$\begin{aligned}
 \therefore \Delta S_{\text{system}} &= -\frac{q}{T_1} \\
 \Delta S_{\text{surrounding}} &= \frac{q}{T_2} \\
 \Delta S &= \Delta S_{\text{system}} + \Delta S_{\text{surrounding}} \\
 &= -\frac{q}{T_1} + \frac{q}{T_2} = q \left[\frac{T_2 - T_1}{T_1 T_2} \right]
 \end{aligned}$$

But $T_1 > T_2 \Rightarrow T_1 - T_2 = +ve$

$\therefore \Delta S_{\text{system}} + \Delta S_{\text{surrounding}} > 0$ for all irreversible process.

Now consider a reversible process. In this process, heat gain from surrounding in one direction is equal to heat lost in reverse direction, hence net entropy change is zero.

$$\Delta S_{\text{system}} = \frac{q}{T}; \Delta S_{\text{surrounding}} = -\frac{q}{T}$$

$$\Delta S = \Delta S_{\text{system}} + \Delta S_{\text{surrounding}} = \frac{q}{T} - \frac{q}{T} = 0$$

3. How can we cool a substance like helium to a very low temperature (4 K)? *(Jagannath A S, Kerala)*

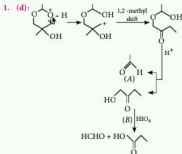
Ans. Helium is a gas at ordinary room temperatures and pressures. It is very difficult to cool or liquefy the helium gas to a very low temperature i.e., at 4 K. At this temperature every other known substance is solid. However the Linde method can be used for cooling of Helium. In this method, the helium gas has first to be cooled below the inversion temperature of 51 K by passing it through the cooler, which is a coiled pipe immersed in a bath of liquid hydrogen at 20 K. The gas then enters the countercurrent heat exchanger at 20 K, at a high pressure, where it is throttled through a valve. There it undergoes cooling, but not enough to cause liquefaction immediately. The cooled gas passes out through the heat exchanger and, in doing so, cools the incoming gas below 20 K. This gas in its turn expands and cools the next amount of incoming gas even more. Eventually, the temperature on the inlet side of the throttling valve is low enough for liquefaction to occur and the liquid helium collects at the bottom of the heat exchanger container at 4 K and at a pressure of 1 atmosphere.

GLIMPSE OF NEXT ISSUE...

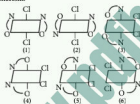
- Focus NEXT
 - Hydrocarbons
 - Environmental Chemistry
- Focus NEXT
 - Polymers
 - Chemistry in Everyday Life
- CISE Board Practice Paper - XI
- CISE Practice Paper - XI
- Get Up for JEE Main: Practice Paper

CHEMISTRY MUSING

SOLUTION SET 65

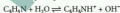
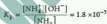


2. (d): Glycinate ion ($\text{H}_2\text{NCH}_2\text{COO}^-$) is not ambidentate ligand. So, it cannot exhibit linkage isomerism.



Structures 1, 2, 3, 4 and 5 are geometrical isomers, whereas 5 and 6 are optical isomers.

3. (a): The two equilibria existing in the same solution are



$$K_b = \frac{[\text{C}_5\text{H}_5\text{NH}^+][\text{OH}^-]}{[\text{C}_5\text{H}_5\text{N}]} = 1.52 \times 10^{-9}$$

Considering the first reaction, the concentration of ammonia is

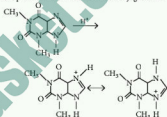
$$= \frac{0.005}{0.200} = 0.025 \text{ M}$$

$$\text{Therefore, } K_b = 1.8 \times 10^{-5} = \frac{x^2}{0.025}$$

$$\text{or } x = 6.7 \times 10^{-4} \text{ M} = [\text{NH}_4^+] = [\text{OH}^-]$$

Now, since the dissociation constant of pyridine is much less than that of ammonia, the OH^- obtained from pyridine will be negligible as compared to those obtained from NH_4OH . Therefore, we need not consider the second equilibrium and report the value as $6.7 \times 10^{-4} \text{ M}$.

4. (b): III is most basic nitrogen because protonation here produces resonance stabilised conjugate acid.



I is least basic as lone pair of nitrogen is delocalised over two carbonyl groups. II is less basic than IV.

5. (c): $X = \text{Sn}(\text{OH})\text{Cl}$, $Y = \text{Sn}(\text{OH})_2$, $Z = \text{Na}_2\text{SnO}_3$, $P = \text{Au}$, $Q = \text{Hl}$
6. (b): Let the number of moles of $\text{C}_6\text{H}_{12}\text{O}_6$ is m and total volume of O_2 used is $2V\text{L}$ at 0°C and 1 atm (NTP).

$$\therefore \text{Volume of } \text{O}_2 \text{ reacted } V\text{L}$$

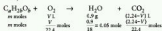
$$\text{and volume of } \text{O}_2 \text{ remaining} = V\text{L}$$

Given,

$$\text{volume of } \text{O}_2 \text{ not reacted} + \text{volume of } \text{CO}_2 \text{ formed} = 2.24 \text{ L}$$

$$\therefore \text{Volume of } \text{CO}_2 \text{ formed} = (2.24 - V) \text{ L}$$

Thus,



$$a \times \text{moles of } \text{C}_6\text{H}_{12}\text{O}_6 = \text{moles of } \text{CO}_2$$

$$\text{or } a \times m = \frac{2.24 - V}{22.4} \quad \text{---(i)}$$

$$2b \times \text{moles of } \text{C}_6\text{H}_{12}\text{O}_6 = 2 \times \text{moles of } \text{H}_2\text{O}$$

$$2b \times m = 2 \times 0.05 = 0.1 \quad \dots(\text{ii})$$

$$b \times \text{moles of } C_6H_{10}O_3 + 2 \times \text{moles of } O_2 \\ = 1 \times \text{moles of } H_2O + 2 \times \text{moles of } CO_2$$

$$b \times m + 2 \times \frac{V}{22.4} = 0.05 + 2 \times \frac{2.24 - V}{22.4} \quad \dots(\text{iii})$$

Substituting the value of $(b \times m)$ from eq. (ii) in (iii) we get,

$$V = 1.12$$

Putting the value of V in eq.(i), we get

$$a \times m = 0.05 \quad \dots(\text{iv})$$

Dividing eq. (iv) by eq. (iii),

$$\frac{a}{b} = 1 \quad \dots(\text{v})$$

Now, from the vapour pressure data, calculate the molecular mass of $C_6H_{10}O_3$.

From Raoult's law, we know

$$\frac{\text{Decrease in VP}}{\text{VP of solvent}} = \frac{\text{moles of solute}}{\text{moles of solute} + \text{moles of solvent}}$$

$$\frac{0.104}{17.5} = \frac{\frac{M}{50}}{\frac{M}{50} + \frac{1000}{18}} \quad (\text{where } M = \text{mol. mass of } C_6H_{10}O_3)$$

$$\therefore M = 150$$

From the formula of $C_6H_{10}O_3$ we get

$$12a + 18b = 150 \quad \dots(\text{vi})$$

From eqs. (v) and (vi), $a = 5$, $b = 5$

Hence, the molecular formula of the organic compound is $C_5H_{10}O_5$.

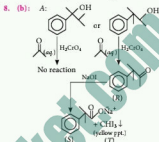
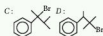
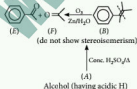
7. (b): E:

F: Can give haloform test

B: Cannot show geometrical isomerism (alkene)

C: Optically active

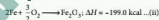
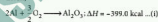
A: Has acidic H



9. (4): The desired chemical change is



Given,



Subtracting eq. (ii) from eq. (i)



Fuel mixture

Volume of fusion mixture = vol. of Al + vol. of Fe_2O_3

$$= \frac{54}{2.7} + \frac{160}{5.2} = 20 + 30.76 = 50.76 \text{ mL}$$

\therefore 50.76 mL mixture produces heat = 200 kcal

\therefore 1 mL mixture will produce

$$= \frac{200}{50.76} = 3.94 = 4 \text{ kcal/mL} \quad (\text{i.e., fuel value/mL})$$

10. (4): Electrolysis of NaCl aqueous solution (X) gives NaOH (A), H_2 (B) and Cl_2 (C).



cold and dil. (Y) (X)



hot and conc. (Z) (X)

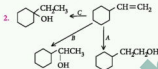
The difference in the oxidation states of Cl in $NaOCl$ and $NaClO_3$ is 4.

GEAR UP FOR JEE MAIN 2019

Exam Dates : Between 6th to 20th January and between 6th to 20th April 2019

1. $N_0/2$ atoms of $X_{(g)}$ are converted into $X_{(g)}^+$ by energy E_1 . $N_0/2$ atoms of $X_{(g)}$ are converted into $X_{(g)}^-$ by energy E_2 . Hence, ionisation potential and electron affinity of $X_{(g)}$ are

- (a) $\frac{2E_1}{N_0}, \frac{2(E_1 - E_2)}{N_0}$ (b) $\frac{2E_1}{N_0}, \frac{2E_2}{N_0}$
(c) $\frac{(E_1 - E_2)}{N_0}, \frac{2E_2}{N_0}$ (d) none is correct



Schemes A, B, C are

I. acid-catalysed hydration

II. hydroboration-oxidation

III. oxymercuration-demercuration

(a) I in all cases (b) I, II, III

(c) II, III, I (d) III, I, II

3. Bleaching powder has two types of chlorine atoms with oxidation number of +1 and -1. It can be represented as

- (a) $\text{Ca}^{2+}(\text{ClO}_2^-)\text{Cl}^-$ (b) $\text{Ca}^{2+}(\text{ClO}_3^-)\text{Cl}^-$
(c) $\text{Ca}^{2+}(\text{ClO}^-)\text{Cl}^-$ (d) $\text{Ca}^{2+}(\text{ClO}^-)\text{Cl}^-$

4. Which of the following statements regarding chemical properties of acetophenone are wrong?

I. It is reduced to methyl phenyl carbinol by sodium and ethanol.

II. It is oxidised to benzoic acid with acidified KMnO_4 .

III. It does not undergo electrophilic substitution like nitration at *meta*-position.

IV. It does not undergo iodoform reaction with iodine and alkali.

- (a) I and II only (b) II and IV only
(c) III and IV only (d) I and II only

5. Ninhydrin  exists as a hydrate.

Which C=O gets hydrated?

- (a) 1 (b) 2
(c) 3 (d) All of these

6. Potassium fluoride (KF) has NaCl structure. Its density is 2.48 g cm^{-3} and its molar mass is 58 g mol^{-1} . Compute the distance between K^+ and F^- ions in KF.

- (a) 537.55 (b) 358.35
(c) 268.75 (d) 134.35

7. Match Column-I with Column-II and select the correct answer using the codes given below.

Column-I

Column-II

A. Ti

p. Bauxite

B. Si

q. Cerussite

C. Al

r. van-Arkel method

D. Pb

s. Zone-refining

(a) A \rightarrow q; B \rightarrow p; C \rightarrow s; D \rightarrow r

(b) A \rightarrow q; B \rightarrow p; C \rightarrow r; D \rightarrow s

(c) A \rightarrow r; B \rightarrow p; C \rightarrow q; D \rightarrow r

(d) A \rightarrow r; B \rightarrow s; C \rightarrow p; D \rightarrow q

8. The solutions A and B are 0.1 and 0.2 molar in a substance. If 100 mL of A are mixed with 25 mL of B and there is no change in volume, then the final molarity of the solution is

- (a) 0.15 M (b) 0.18 M
(c) 0.12 M (d) 0.30 M

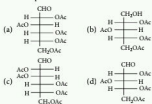
9. Acetanilide on nitration followed by alkaline hydrolysis mainly gives

- (a) *o*-nitroacetanilide (b) *p*-nitroaniline
(c) *m*-nitroaniline (d) 2,4,6-trinitroaniline.

10. Saline hydrides are known to react with water violently producing fire. The fire cannot be extinguished by CO_2 because

- (a) CO_2 is lighter than the gas evolved
 (b) CO_2 is heavier than the gas evolved
 (c) CO_2 gets reduced by the unreacted saline hydride
 (d) CO_2 gets reduced by the gas evolved
11. The vapour pressure of a solution containing 2 g of an electrolyte BA in 100 g water, which dissociates as B^+ and A^- ion in water is 751 mm at 100°C . Calculate degree of ionisation of BA if its mol. wt. is 56.
- (a) 28.12% (b) 86.42%
 (c) 50.91% (d) 98.21%

12. $D\text{-Glucose} \xrightarrow[\text{HCl}]{\text{CH}_3\text{CH}_2\text{SH}} \xrightarrow[(\text{b}) \text{Hg}^{2+}]{(\text{a}) \text{Ac}_2\text{O}} \text{X}$
 The final product 'X' is

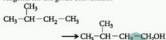


13. The energy levels for $\text{A}^{+(Z-1)}$ can be given by
 (a) E_n for $\text{A}^{+(Z-1)} = Z^2 \times E_n$ for H
 (b) E_n for $\text{A}^{+(Z-1)} = Z \times E_n$ for H
 (c) E_n for $\text{A}^{+(Z-1)} = \frac{1}{Z^2} \times E_n$ for H
 (d) E_n for $\text{A}^{+(Z-1)} = \frac{1}{Z} \times E_n$ for H
14. Which one of the following molecules cannot serve as a monomer for an addition polymer?
 (a) $\text{C}\equiv\text{CH}_2$ (b) $\text{CH}_2=\text{CHCN}$
 (c) $\text{CH}_2=\text{CHC}_6\text{H}_5$ (d) $(\text{CH}_2\text{OH})_2$

15. Consider the following statements:
 I. BeO is insoluble but BeSO_4 is soluble in water.
 II. BaO is insoluble but BaSO_4 is soluble in water.
 III. LiI is more soluble than KI in ethanol.
 The true statements are
 (a) I and II only (b) I and III only
 (c) II and III only (d) I, II and III

16. In the following first order competing reactions:
 $\text{A} + \text{Reagent} \longrightarrow \text{Product}$
 $\text{B} + \text{Reagent} \longrightarrow \text{Product}$
 The ratio of k_1/k_2 , if only 50% of B will have been reacted when 94% of A has been reacted is
 (a) 4.06 (b) 0.246 (c) 2.06 (d) 0.06

17. Which of the following is the best sequence of reagents for the given conversion?

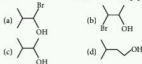
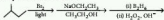


- I. $\text{Cl}_2, \text{h}\nu$: monochlorination
 II. $\text{Br}_2, \text{h}\nu$: monobromination
 III. $\text{CMe}_2\text{O}^+ / \text{CMe}_2\text{OH}$
 IV. $\text{KOH}, \text{CH}_3\text{CH}_2\text{OH}, \Delta$
 V. conc. $\text{HCON}(\text{CH}_3)_2$
 VI. HCl
 VII. HBr , peroxide
 VIII. $\text{BH}_3\text{-THF}, \text{H}_2\text{O}_2, \text{OH}^-$
 (a) I, IV, VI, VII (b) I, III, VII, VIII
 (c) II, IV, VII, III, VIII (d) II, III, VII, VIII
18. Boiling point of a liquid is 50 K at 1 atm and $\Delta H_{\text{vap}} = +60.6 \text{ cal mol}^{-1}$. What will be its b.p. at 10 atm?
 (a) 150 K (b) 75 K (c) 100 K (d) 200 K
19. Structurally biodegradable detergents should contain
 (a) normal alkyl chain
 (b) branched alkyl chain
 (c) phenyl side chain
 (d) cyclohexyl side chain.
20. Which of the following are used as transition materials and light-emitting devices (LED)?
 I. Gallium-phosphides
 II. Indium-phosphides
 III. Gallium-arsenides
 IV. Indium-arsenides
 (a) All (b) All except I
 (c) All except I, II (d) Only IV
21. $\text{Cu}_{(\text{aq})}^+$ is unstable in solution and undergoes simultaneous oxidation and reduction according to the reaction, $2\text{Cu}_{(\text{aq})}^+ \rightleftharpoons \text{Cu}_{(\text{aq})}^{2+} + \text{Cu}_{(\text{s})}$. Choose the correct E° for above reaction if $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ and $E^\circ_{\text{Cu}^+/\text{Cu}} = 0.15 \text{ V}$.
 (a) -0.38 V (b) $+0.49 \text{ V}$
 (c) $+0.38 \text{ V}$ (d) -0.19 V
22. The basic character of the transition metal monoxide follows the order:
 (a) $\text{TiO} > \text{VO} > \text{CrO} > \text{FeO}$
 (b) $\text{VO} > \text{CrO} > \text{TiO} > \text{FeO}$
 (c) $\text{CrO} > \text{VO} > \text{FeO} > \text{TiO}$
 (d) $\text{TiO} > \text{FeO} > \text{VO} > \text{CrO}$

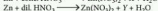
23. Slaked lime, Ca(OH)_2 is used extensively in sewage treatment. What is the maximum pH that can be established in Ca(OH)_2 (aq)?
 $\text{Ca(OH)}_2(a) \rightleftharpoons \text{Ca}^{2+}(aq) + 2\text{OH}^-(aq)$ $K_{sp} = 5.5 \times 10^{-6}$

(a) 1.66 (b) 12.35 (c) 7 (d) 14

24. Major organic product formed from the following sequence of reactions is



25. The following two reactions of HNO_3 with Zn are given as (equations are not balanced):



In the above reactions, the compounds X and Y respectively, are

(a) N_2O and NO_2 (b) NO_2 and NO_2
 (c) NO and NO_2 (d) NO_2 and N_2O

26. In Langmuir's model of adsorption of a gas on a solid surface

- (a) the rate of desorption of adsorbed molecules from the surface does not depend on the surface covered
 (b) the adsorption at a single site on the surface may involve multiple molecules at the same time
 (c) the mass of gas striking a given area of surface is proportional to the pressure of the gas
 (d) the mass of gas striking a given area of surface is independent of the pressure of the gas.

27. 5.0 L water is placed in a closed room of volume 2.5×10^4 L having temperature 300 K. If vapour pressure of water is 27.0 mm and density is 0.996 g/cm^3 at this temperature, how much water is left in liquid state?

(a) 3.444 L (b) 4.344 L (c) 4.798 L (d) 1.212 L

28. The correct order for the wavelength of absorption in visible region is

(a) $[\text{Ni}(\text{NO}_2)_6]^{4-} < [\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
 (b) $[\text{Ni}(\text{NO}_2)_6]^{4-} < [\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NH}_3)_6]^{2+}$
 (c) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{NO}_2)_6]^{4-}$
 (d) $[\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NO}_2)_6]^{4-}$

29. Three test tubes A, B, C contain any of these Pb^{2+} , Hg_2^{2+} and Ag^+ ions. To each aqueous solution,

NaOH is added in excess. Following changes occur.

A : Black ppt.

B : Brown ppt.

C : White ppt. but dissolves in excess of NaOH

A, B and C contain respectively

(a) Pb^{2+} , Hg_2^{2+} and Ag^+ (b) Hg_2^{2+} , Ag^+ , Pb^{2+}

(c) Ag^+ , Pb^{2+} , Hg_2^{2+} (d) Ag^+ , Hg_2^{2+} , Pb^{2+}

30. Consider two elements with atomic no. 37 and 53, the bond between their atoms would be

(a) covalent (b) ionic
 (c) coordinate (d) metallic.

SOLUTIONS

1. (b) : $X_{(g)} \longrightarrow X_{(g)}^+ + e^-$; E_1 for $\frac{N_0}{2}$ atoms

$\frac{N_0}{2}$ atoms of $X_{(g)}$ have been ionised by energy = E_1


Thus, ionisation energy of $X_{(g)} = \frac{2E_1}{N_0}$ per atom.

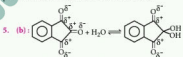
$X_{(g)} + e^- \longrightarrow X_{(g)}^-$; E_2 for $\frac{N_0}{2}$ atoms

Thus, electron affinity of $X_{(g)}$ is $\frac{2E_2}{N_0}$ per atom.

2. (c)

3. (d)

4. (c) : Acetophenone  COCH_3 undergoes usual electrophilic substitution reaction and also gives positive iodoform test with iodine and alkali.



The adjacent δ^+ are separated by the hydration of middle carbonyl group.

6. (c) : Since NaCl has fcc structure, therefore, KF also has fcc structure. For a face-centred cubic lattice, the distance between the cation and anion is equal to the sum of their radii which is equal to half of the edge length of the unit cell, thus

$$r^+ + r^- = \frac{a}{2} \text{ and } a^3 = \frac{Z \times M}{\rho \times N_A}$$

MONTHLY TUNE UP CLASS XII

ANSWER KEY

1. (d) 2. (d) 3. (a) 4. (c) 5. (c)
 6. (a) 7. (d) 8. (b) 9. (b) 10. (d)
 11. (a) 12. (b) 13. (d) 14. (a) 15. (b)
 16. (d) 17. (b) 18. (d) 19. (b) 20. (a,d)
 21. (b,c,d) 22. (a,b,d) 23. (b,c) 24. (6) 25. (4)
 26. (7) 27. (d) 28. (b) 29. (a) 30. (c)

Given that : $Z = 4$, $M = 58 \text{ g mol}^{-1}$, $\rho = 2.48 \text{ g cm}^{-3}$

$$a^3 = \frac{4 \times 58}{2.48 \times 6.023 \times 10^{23}} = 155.318 \times 10^{-24} \text{ cm}^3$$

or $a = 5.375 \times 10^{-8} \text{ cm} = 537.5 \text{ pm}$

$$r^+ + r^- = \frac{a}{2} = \frac{537.5}{2} = 268.75 \text{ pm}$$

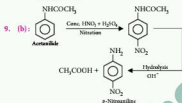
7. (d)

8. (c) : Milli-mole of A = $100 \times 0.1 = 10$

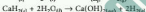
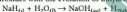
Milli-mole of B = $25 \times 0.2 = 5$

Total milli-mole = $10 + 5 = 15$

$$\therefore M = \frac{15}{100+25} = \frac{15}{125} = 0.12$$



10. (c) : Saline hydrides (such as NaH, CaH₂, etc.) react with water violently to form the corresponding metal hydroxides with the evolution of dihydrogen.



These reactions are so much exothermic that the evolved H₂ catches fire. This type of fire cannot be extinguished by CO₂ because it gets reduced by the hot metal hydride to form sodium formate.



11. (b) : $\frac{P^* - P_s}{P_s} = \frac{n \times M}{m \times W}$

$$\frac{760 - 751}{751} = \frac{2 \times 18}{m \times 100} \Rightarrow m_{\text{exp}} = 30.04$$



Before dissociation : 0 0

After dissociation : $(1 - \alpha)$ α α

$$\text{Now, } \frac{m_{\text{theor}}}{m_{\text{exp}}} = 1 + \alpha$$

$$\therefore \frac{56}{30.04} = 1 + \alpha$$

$$\therefore \alpha = 0.8642 \text{ or } 86.42\%$$

12. (a)

13. (a) : $E_n = -\frac{E_1}{n^2} \times Z^2$

$$E_{1e^+} = E_{1H} \times 2^2; E_{1e^+} = E_{1H} \times 2^2$$

14. (d) : In addition polymerization, the monomers are unsaturated compounds.

15. (b)

16. (a) : $k_2 = \frac{2.303}{t_2} \log \frac{100}{50}$ for 50% B reacted

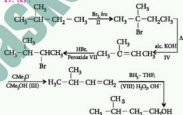
$$k_1 = \frac{2.303}{t_1} \log \frac{100}{6}$$

$$\therefore \frac{k_2}{k_1} = \frac{t_1}{t_2} \times \frac{0.3010}{1.2218}$$

Since $t_2 = t_1$, because 50% B has reacted when 94% A has been reacted.

$$\therefore \frac{k_2}{k_1} = \frac{0.3010}{1.2218} = 0.246 \text{ and } \frac{k_1}{k_2} = 4.06$$

17. (c) :



18. (c) : $2.303 \log \frac{P_2}{P_1} = \frac{\Delta H}{R} \left[\frac{T_2 - T_1}{T_1 T_2} \right]$

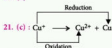
$$\therefore 2.303 \log \frac{10}{1} = \frac{460.6}{2} \times \left[\frac{T_2 - 50}{50 \times T_2} \right] \Rightarrow T_2 = 100 \text{ K}$$

EXAM ALERT 2019

Exam	Date
JEE Main I	6 th to 20 th January
JEE Main II	6 th to 20 th April
VITEEE	10 th to 21 st April
SRMJEE	15 th to 25 th April
AMU (Engg.)	28 th April
NEET	5 th May
COMEDK (Engg.)	12 th May
JEE Advanced	19 th May
AIMS	25 th & 26 th May

19. (a) : Lesser the branching, greater the biodegradability.

20. (a)



$$E^\circ_{\text{Cu}^+/\text{Cu}^{2+}} = -E^\circ_{\text{Cu}^{2+}/\text{Cu}^+} = -0.15 \text{ V}$$

$$E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V} \quad (\text{Given})$$

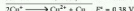
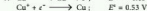


$$\Delta G^\circ_3 = \Delta G^\circ_1 + \Delta G^\circ_2$$

$$-n_3 F E^\circ_3 = -n_1 F E^\circ_1 - n_2 F E^\circ_2$$

$$\therefore E^\circ_3 = \frac{n_1 E^\circ_1 + n_2 E^\circ_2}{n_3} = \frac{2 \times 0.34 + 1(-0.15)}{1}$$

$$\therefore E^\circ_{\text{Cu}^+/\text{Cu}} = 0.53 \text{ V}$$



22. (a) : Basic character of oxides decreases from left to right in a period of Periodic Table.

23. (b) : $K_{sp} = 5.5 \times 10^{-6}$



$$[\text{Ca}^{2+}][\text{OH}^-]^2 = 5.5 \times 10^{-6}$$

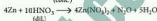
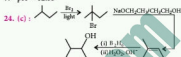
$$4s^3 = 5.5 \times 10^{-6}$$

$$s = 0.0111$$

$$\therefore [\text{OH}^-] = 2s = 0.0111 \times 2 = 0.0222$$

$$\therefore \text{pOH} = 1.65$$

$$\therefore \text{pH} = 12.35$$



26. (c) : According to Langmuir, $\frac{x}{m} \propto P$
(specifically for chemisorption)

27. (b) : For H_2O vapours, $PV = nRT$

$$\frac{27}{760} \times 2.5 \times 10^4 = n \times 0.0821 \times 300 \Rightarrow n = 36.1$$

$$\therefore \text{Mass of } \text{H}_2\text{O} \text{ in the form of vapours} = 36.1 \times 18 = 649.8 \text{ g}$$

$$\therefore \text{Volume of } \text{H}_2\text{O}_{(g)} \text{ evaporated} = \frac{649.8}{0.990} = 656.4 \text{ mL}$$

$$\therefore \text{Volume of } \text{H}_2\text{O}_{(l)} \text{ left} = (5.0 - 0.6564) = 4.344 \text{ L}$$

28. (a) : In the spectrochemical series, the order of the ligands is $\text{H}_2\text{O} < \text{NH}_3 < \text{NO}_2^-$ and the wavelength absorbed will be in the opposite direction as $E = 1/\lambda$.

29. (b)

30. (b)

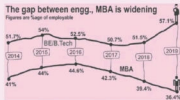


India Skills Report: Engineering graduates more employable than MBAs

India Skills report is to provide an insight into the hiring trends of the market while understanding the needs of the job seeker and organisations. As per the report, 1.5 million engineers pass out every year but only 52% are employable, highest employable population across domains.

Annually about 3,60,000 MBA students pass out from 4000 B-schools in India and only 39% are employable due to skill gaps and lesser work experience.

ITI has highest skill gap followed by Polytechnic, even though both are skill-oriented courses and this skill gap reveals the level of education in both the courses.



Education wise employability percentage

The survey showed that MBA courses have lost some of their appeal with employability dropping 3 percentage point over the last year, according to the India Skills report 2019 prepared by People Strong, Wheelbox and CII in partnership with the AICTE, UNDP and the Association of Universities.



5 REASONS

WHY MOCK TEST PAPERS ARE IMPORTANT

For any exam whether it is a competitive or Nationalised entrance exam, it is only through practicing that a candidate can secure good score or rank. Practice makes your concepts clear and you are able to assess your preparation for the upcoming exams. Mock test papers are the best resource for practicing and to keep a constant check on your preparation level. Hence, it is necessary that candidates take up mock tests before going for the actual exams. In this article, we have come up with 5 benefits of attempting Mock Test Papers to emphasize its importance during Exam preparation.

1. HELPS TO FAMILIARIZE WITH REAL EXAM ENVIRONMENT

Mock test papers are designed as per the actual test papers. These test papers acquaint you with the question pattern, syllabus, difficulty level. Thereby, giving mock test papers help candidates to get familiarized with the actual exam-environment. Attempt MTG's Online Mock Tests Series from test.pcmb.com to get familiarized with respective exam pattern.

2. PREVENTS NERVOUSNESS AND BOOST CONFIDENCE

Stress and anxiety are two factors that go hand-in-hand during exam preparation. These factors can adversely affect exam performance. It has been observed quite a few times, that candidates lose marks because of being too nervous or over-stressed. When you are nervous, it affects your memory and concentration which some time, may cause "blank-out" during the exam. If you can get familiar with the exam pattern, you can overcome this exam fear. Rigorous practice of mock tests will make you exam ready and will boost your confidence for the exams.

3. IMPROVES YOUR SPEED AND TIME MANAGEMENT

Getting familiar with exam pattern will also help you in managing the simulated exam time. Time management plays a crucial role during exams. Most of the candidates are unable to complete their exam paper within

the given time and lose marks, despite of knowing the correct answers. Candidates often face difficulty in attempting all the questions with absolute accuracy in the given time. Mock test papers are designed as per the actual test paper pattern, solving them will help you to manage your time and correctly answer the entire question paper. Thereby, improving your speed and accuracy. Practice solving Mock Test Papers from MTG Book series to improve your speed and manage your time during exam.

4. REVISION OF COMPLETE SYLLABUS

The most common problem that students face during their exam preparation is that they start forgetting the earlier chapters once they proceed with their preparations. Mock Test papers are designed so that they cover almost every important topic of the syllabus. Hence, solving them will help students in getting a complete revision of the syllabus regularly. This will help them to retain all the learned chapters till the exam day. So, practice as many Mock tests as you can to brush up all topics in a better way.

5. UNDERSTAND YOUR STRENGTH AND WEAKNESSES

Once you are prepared for the upcoming exams, it is necessary to test your preparation level. It is always important to do a self-analysis of your preparations. Appearing for Mock Tests can help you understand the level of your preparedness. You will be able to know the areas you are lagging in and where to put more effort. Get a thorough self-analysis after completing your preparation by solving powerful Mock test papers provided in MTG Books for competitive exams. These books are provided with detailed solutions which will not only help to assess your knowledge but also help you to learn the concepts clearly.

We hope this article will help you to understand the importance of Mock Tests. So, if you want to score more and be confident for your exams, it is always advisable to solve Mock Tests.

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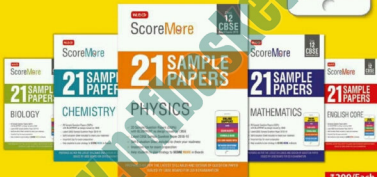
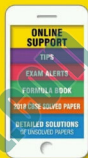
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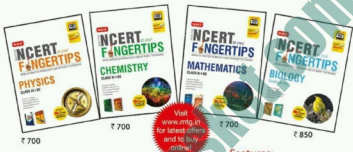
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